



IVAC® Volumetric Pump

Models 597 and 598

Technical Service Manual



Contents

Chapter 1 Introduction	4
Chapter 2 Routine Maintenance & Calibration	9
Chapter 3 Troubleshooting	28
Chapter 4 Circuit Descriptions	34
Chapter 5 Spare Parts Replacement Procedures	38
Appendix A Specifications	54
Appendix B Spare Parts Listing	60
Appendix C Fitting & Replacement Guidelines	66
Appendix D Service Contacts	68
Appendix E Disposal	70
Appendix F Document History	72

Chapter 1

Introduction

In this chapter

Introduction	5
General Precautions	6
Views of the IVAC® Volumetric Pump (Models 597 & 598)	7
Controls and Indicators	8
Flow Sensor	8

Introduction

The IVAC® Volumetric Pump - Models 597 & 598 automatically regulates the infusion rate of IV solutions using a linear peristaltic, volume displacement mechanism to regulate fluid flow at the prescribed rate. The pump can be operated with a Flow Sensor and is lightweight, compact and robust enough for most patient situations.

The IVAC® 598 Volumetric Pump operates in primary infusion mode only.

The IVAC® 597 Volumetric Pump has a primary and secondary infusion feature.

Product Familiarity

Ensure that you are fully familiar with the pump by carefully studying the *Directions for Use (DFU)* prior to operation and prior to attempting any repairs or servicing. As part of continuous improvement, product enhancements and changes are introduced from time to time.

Purpose of this Manual

This Technical Service Manual describes how to set up, test and maintain the following volumetric pumps:

IVAC® 597 Volumetric Pump

IVAC® 598 Volumetric Pump

This manual is intended for use by personnel experienced in medical equipment testing and maintenance procedures.

Conventions Used in this Manual

BOLD	Used for Display names, self-test codes, controls and indicators referenced in this manual, for example, VTBI indicator , test code 08 , ON/OFF switch.
'Single quotes'	Used to indicate cross-references made to another section of this manual. For example, see Chapter 2, 'Configuration and Calibration'.
<u>underline</u>	Used to indicate a link to another section within this manual.
<i>Italics</i>	Used to refer to other documents or manuals. For example, refer to the relevant <i>Directions for Use (DFU)</i> for further information. Also used for emphasis, for example, ...if the gap <i>still</i> measures less than...
	Wherever this symbol is shown a Hints & Tips note is found. These notes provide useful advice or information that may help to perform the task more effectively.
	Wherever this symbol is shown a Toolbox note is found. These notes highlight an aspect of test or maintenance that is important to know about. A typical example is drawing attention to a software upgrade that you should check has been installed.

General Precautions



Prior to using this pump, carefully read the Operating Precautions described in the *Directions for Use (DFU)*.



This pump contains static-sensitive components. Observe strict precautions for the protection of static sensitive components when attempting to repair and service the pump.



An explosion hazard exists if the pump is used in the presence of flammable anaesthetics. Exercise care to locate the pump away from any such hazardous sources.



Dangerous Voltage. An electrical shock hazard exists if the casing of the pump is opened or removed. Refer all servicing to qualified service personnel.



This pump is protected against the effects of high energy radio frequency emissions and is designed to be fail safe if extremely high levels of interference are encountered. Should false alarm conditions be encountered, either remove the source of the interference or regulate the infusion by another appropriate means.



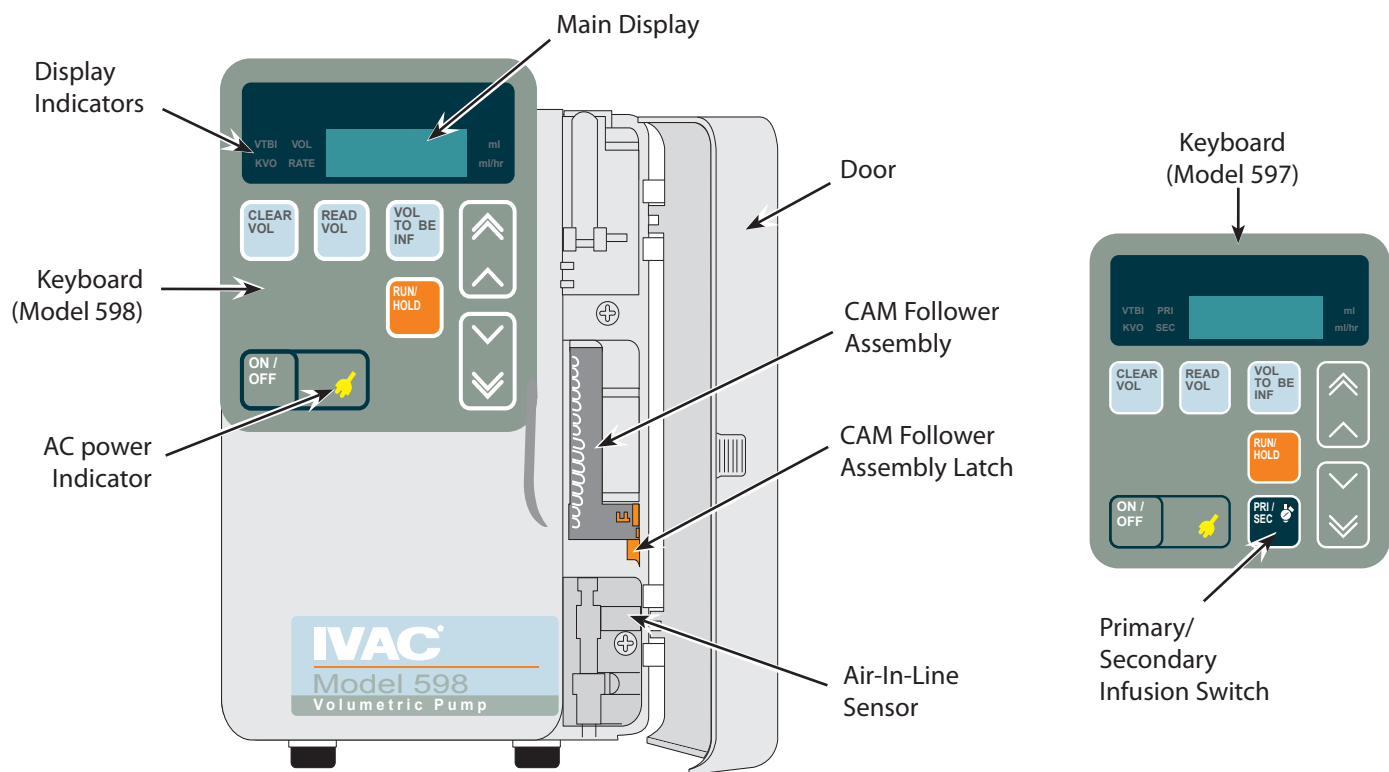
If the pump is dropped, subjected to excessive moisture, humidity or high temperature, or otherwise suspected to have been damaged, remove it from service for inspection by qualified service personnel.



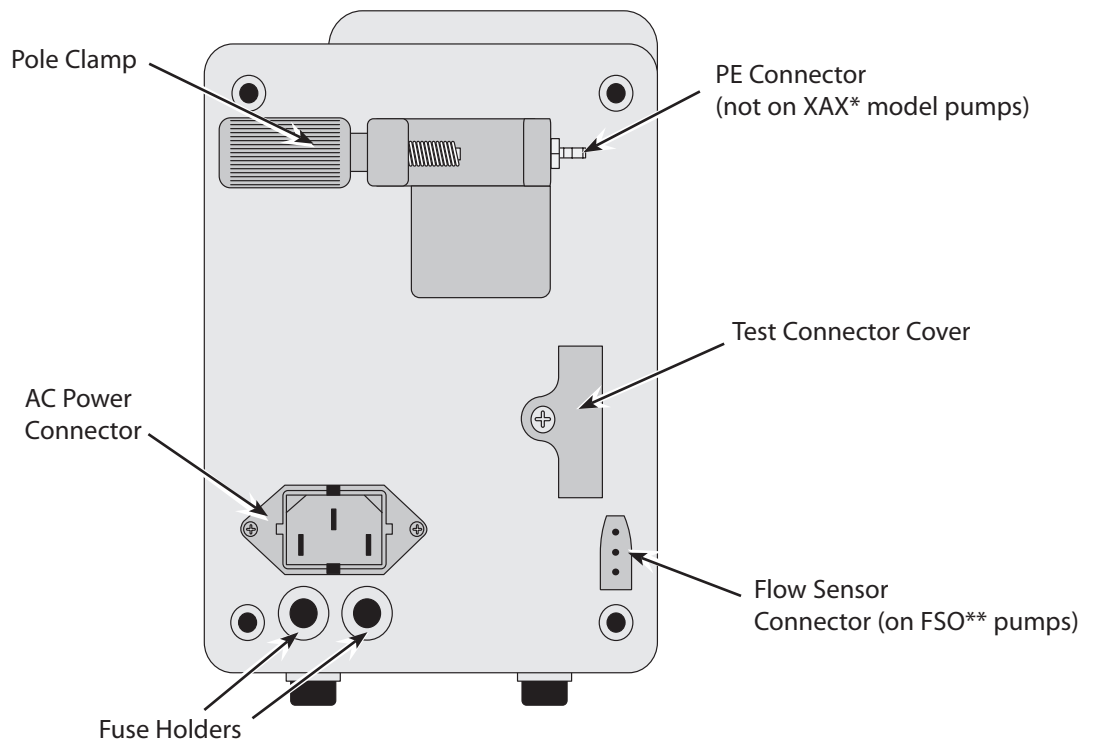
When connected to an external power source, a three-wire (Live, Neutral, Earth) supply must be used. If the integrity of the external protective conductor in the installation or its arrangement is in doubt, the pump should be operated from the battery.

Views of the IVAC® Volumetric Pump (Models 597 & 598)

Front View



Rear View



* XAX refers to pumps with Serial numbers that include XAX, for example, 597XAX01AA.

** Flow Sensor Option.

Controls and Indicators

The English keyboard controls and indicators are described below. For information on keyboards in other languages, refer to the relevant DFU. See also Appendix B, 'Spare Parts Listing' for keyboard part numbers.

	CLEAR VOLUME	Resets volume infused value to zero.
	READ VOLUME	Displays volume infused value.
	VOLUME TO BE INFUSED (VTBI)	Sets value of Volume To Be Infused.
	RUN/HOLD	Starts and stops pump infusions. Silences/cancels alarms.
	PRIMARY/ SECONDARY	(Model 597 only). Switches the pump between PRIMARY and SECONDARY infusion modes.
 	CHEVRONS	Double chevrons/single chevrons for faster/slower increase or decrease of infusion rate and volume values. Adjusts user selectable options (in self-test mode).
	ON/OFF	Switches the pump on and off.

When any of the following are illuminated:



AC POWER INDICATOR - The pump is connected to an AC power supply and the battery is being charged.

VTBI The value displayed is the Volume To Be Infused.

KVO The pump is infusing at the Keep Vein Open (KVO) rate of 5ml/h (or current rate, whichever is less).

VOL The value displayed is the volume infused.

RATE The value displayed is the current infusion rate.

PRI (Model 597 only). The pump is operating in PRIMARY mode.

SEC (Model 597 only). The pump is operating in SECONDARY mode.

ml (Millilitres) The value displayed is the VTBI or volume infused value.

ml/hr (Millilitres / hour) The value displayed is the infusion rate.



Infusion indicator. Three horizontal bars in the left-hand display position flash sequentially when the pump is infusing.



Infusion indicator with Flow Sensor in use. Upper two horizontal bars convert to a square when a drop is detected by the flow sensor in the drip chamber.

Flashing
Display

When the pump is operating on battery power, the Display flashes on/off.

Flow Sensor

A flow sensor is used to detect an empty fluid container. It is connected to the drip chamber and when a drop is detected in the drip chamber the infusion indicator in the top left position of the Display converts to a square character (□). See above.

Notes:

- 1) Use part number 192.
- 2) A flow sensor can only be used on Flow Sensor Option (FSO) pumps.

Routine Maintenance & Calibration

In this chapter

Routine Maintenance	10
Self-Test Mode	10
Test Codes	11
Test Connector	17
Upgrading Software	17
Cam Follower Gap Check	18
Functionality Checks	19
Occlusion Verification Test	20
Rate Accuracy Verification Test (Code 13)	20
Physical Inspection and Clean	21
Calibration Procedures	23
Performance Verification Procedure	27

Routine Maintenance

For routine maintenance, the following tests and Performance Verification Procedures (PVP) should be performed in addition to the tasks described in the section 'Physical Inspection and Clean'.

Refer to the relevant *DFU* for the recommended routine maintenance period.

Self-Test Mode

Self-test mode is used to access a number of test routines which are designed to test and verify many of the pump functions, defaults and calibrations without requiring internal inspection. Configuration settings are also enabled or disabled via self-test mode.

Each test can be run in a single pass or in a continuous loop mode. See 'Test Execution' below for further details. Some tests require a test jumper (part number 134646), see 'Test Connector' for further details.

Test Pass/Fail

The **PRI & SEC** (Model 597) or **RATE & VOL** (Model 598) indicator lights on the front panel of the pump are used to signal whether the pump passes or fails a test as follows:

If the yellow **PRI** (Model 597) or **VOL** (Model 598) indicator light comes on, the pump has passed the test in progress.
If the red **SEC** (Model 597) or **RATE** (Model 598) indicator light comes on, the pump has failed the test in progress.

Most test procedures display data, such as numeric codes to indicate a test failure reason. See 'Test Procedure' table for further details.

Entering Self-Test Mode

- Press the **CLEAR VOL** and **ON/OFF** switches simultaneously until the display turns on. The pump then performs power-on self-tests. Initially, the current software revision level is displayed, followed by the battery voltage.
- When the battery voltage is displayed, press the **RUN/HOLD** switch to display **t=00** which means the pump is ready to start test **00**.

Note: To bypass the display of the software revision level and the battery voltage and advance directly to **t=00**, hold the **CLEAR VOL** switch until the power-on display test completes.

- Use the chevron switches (, ,  and ) to select the test code required.
- To exit self-test mode, turn the pump off.

Test Execution

Single Pass Mode

After selecting the test number (see 'Entering Self-Test Mode' above), press the **RUN/HOLD** switch to start the test for one pass. The display changes to show the test number for example, **t=13**. If there is data to display, it can be viewed after the test by pressing the **READ VOL** switch.

Continuous Loop Mode

Certain tests can be run in a continuous loop mode (see tables below). After selecting the test number, press the **RUN/HOLD** switch twice within one second to enter the test loop. The display will change as in the single pass mode then the test will be repeated continuously until the **RUN/HOLD** switch is pressed again.

To display the test data while the test continues, press the **READ VOL** switch.

To exit the loop, press the **RUN/HOLD** switch.

Exiting Self-Test Mode

Self-mode can be exited at any time turning off the pump.

Test Codes

Summary

Code	Test Name	Code	Test Name
00	Self-Test (01 to 08)	19	EEPROM Test
01	Speaker and Speaker Drive Circuit Test	20	Rate Calibration Number Read
02	Motor and Drive Circuitry Test	21	Total Pump Life "On" Time Read/Clear
03	Pressure Sensor Test	22	Total Battery "On" Time Read/Clear
04	Air-in-line Test	23	Error/Alarm Stack Read/Clear
05	Safety Switch and Driving Circuitry Test	24	Pressure Calibration Read/Set <i>See 'Pressure Calibration' section for details of test.</i>
06	Front Panel LED Test	25	Language Code Read/Set
07	External RAM Test	26	CRIS Configuration
08	Tach/Volume Flag Test	27	Air Bubble Length Read
09	Drop Discriminator Circuitry, Simulated Drop Test	28	FLO Alarm Threshold Read
10	Drop Detector LED Drive Current Test	29	Door Calibration Read/Set <i>See 'Door Calibration' section for details of test.</i>
11	Door Sensor Test	30	Auxiliary Front Panel Display Enable/Disable
12	Dried Spillage Alarm Parameters Read	31	Secondary Mode Setting On/Off
13	Rate Accuracy Test <i>See 'Rate Accuracy Verification Test' section for details of test.</i>	32	Production/Quick Configuration Test <i>Factory Use Only. Test not available.</i>
14	Switch Test	33	Pump Identification Number Read/Set
15	Burn-In Test	34	Hospital or Alternate Site Configuration Set
16	Battery Voltage Test	35	Secondary Mode Enable/Disable (Model 597 only)
17	Seven-Segment Display Test	36	Flow Sensor Optional/Mandatory
18	<i>Factory Use Only</i>		

Test Codes (continued)

Test Procedures

Code	Test	Action/Data Displayed	Loop
00	Self-Test (01 to 08)	The pump cycles through tests 01 through 08 sequentially, displaying the test number in progress, in the format t0.01 through t0.08 . If a test fails, the red SEC (or RATE) indicator lights, the current test stops and the test number is displayed. Press the RUN/HOLD switch once to continue to the next test (or twice to exit the test).	Loop only
01	Speaker and Speaker Drive Circuit Test	Test fail codes: 1=speaker senses as not turning on 2=speaker senses as not turning off	Yes
02	Motor and Drive Circuitry Test	Test fail codes: 1=motor would not turn on (or shorted coil) 2=motor would not turn off	Yes
03	Pressure Sensor Test	Data displayed: D/A trim level is displayed at end of test. Test fail codes: 1 = amplifier output stuck high 2 = amplifier output stuck low 3 = amplifier cannot attain 4.6 volts 4 = amplifier cannot go below 0.2 volts 5 = bridge will not trim (D/A bits bad) 6 = trim/amplifier gain > 4.4 7 = trim/amplifier gain < 3.6	Yes
04	Air-in-line Test	To run the test: • Load an air or fluid-filled IV infusion set. • Press the READ VOL switch to display the output code. Test fail codes: 0 = fluid detected in IV infusion set 1 = air detected in IV infusion set 2 = output stuck high 3 = test line could not force air indication	Yes
05	Safety Switch and Driving Circuitry Test	Test fail codes: 1 = safety logic line would not go low 2 = safety logic line would not turn off 3 = safety switch would not turn on 4 = safety switch would not turn off 5 = both safety switch and motor drive stuck on	Yes
06	Front Panel LED Test	All front panel LEDs are lit until the RUN/HOLD switch is pressed. Inspect LEDs. Note that the AC charge LED only lights on AC power.	Yes
07	External RAM Test	Test fail: display shows the first address failed, hexadecimal. Note that the highest address is tested first.	Yes
08	Tach/Volume Flag Test	Data displayed: tt.vv where tt equals the last two digits of the number of tach flags, and vv equals the number of volume flags. Normal display is 20.28 , and the tt may vary by +/- one count. This test is designed to assist in aligning the encoder disk optics and is intended to be used in the loop mode. When running test, if there is excessive noise, loosen retaining screws as required and adjust the cam follower assembly as far as possible towards the bottom of the pump. Tighten retaining screws then turn the pump off.	Yes
09	Drop Discriminator Circuitry, Simulated Drop Test	Note: The flow sensor must be connected to the pump. Data displayed: output voltage in A/D counts. Ideal value is 205 counts = 4.00 volts Test fail codes: 1 = no drop detected 2 = value too high, max = 4.257 V, 218 counts 3 = value too low, min = 3.750 V 192 counts 4 = simulated drop detected as multiple drops 5 = simulated drop detected as long or small drop	Yes

Test Codes (continued)

Test Procedures (continued)

Code	Test	Action/Data Displayed	Loop																				
10	Drop Detector LED Drive Current Test	Note: The flow sensor must be connected to the pump. Data displayed: LED current, in mA Test fails if the current exceeds 126 mA or falls below 2 mA.	Yes																				
11	Door Sensor Test	OPEN = door sensed as open CLOS = door sensed as closed Press READ VOL switch to display the A/D value. See 'Door Calibration' for instructions on how to read and set door calibration value.	Yes																				
12	Dried Spillage Alarm Parameters Read	See 'Read Parameter/Values' table on the next page.	-																				
13	Rate Accuracy Test	See ' Rate Accuracy Verification Test ' section for details of test.	-																				
14	Switch Test	Press each switch and check the corresponding code is displayed: <table><tr><td></td><td>0</td><td></td><td>5</td></tr><tr><td></td><td>1</td><td></td><td>6</td></tr><tr><td></td><td>2</td><td></td><td>7</td></tr><tr><td></td><td>3</td><td></td><td>8 (hidden switch on Model 598)</td></tr><tr><td></td><td>4</td><td colspan="2">Note: the ON/OFF switch does not have a code.</td></tr></table> To exit this test, press both the RUN/HOLD switch and PRI/SEC (hidden switch on Model 598) switch simultaneously, or turn the pump off.		0		5		1		6		2		7		3		8 (hidden switch on Model 598)		4	Note: the ON/OFF switch does not have a code.		No
	0		5																				
	1		6																				
	2		7																				
	3		8 (hidden switch on Model 598)																				
	4	Note: the ON/OFF switch does not have a code.																					
15	Burn-In Test	All front panel LEDs light continuously (except for run indicator which behaves as if in normal mode). Pump runs at 125 ml/h, all FLO, OCCL, and Air alarms are ignored. Data displayed: All detected errors. Door alarm is also active. Note: It is not possible to run this test if any errors have been detected since entering self-test mode.	No																				
16	Battery Voltage Test	Data displayed: battery voltage, in volts. Test passes with value above 5.7 volts .	Yes																				
17	Seven-Segment Display Test	Test fail codes (LED segment assembly number): 0 = far left, 1 = 2nd from left, 3 = 2nd from right, 4 = far right	No																				
18	Factory Use Only	Factory Use Only	-																				
19	EEPROM Test	Data displayed: number of first registration to fail.	No																				

Read Parameters/Values

Code	Test	Action/Data Displayed	Loop
12	Dried Spillage Alarm Parameters Read	Read parameters by pressing the RUN/HOLD switch four times: 1st press displays the dried spillage scan start volume flag number. 2nd press displays the scan stop volume flag number. 3rd press displays the alarm threshold value. 4th press exits the test.	No
13 through 19		See 'Test Procedures' table on the previous page.	-
20	Rate Calibration Number Read	Read the factory-set calibration number. If the Cam Follower Assembly is replaced and the number is not "0033" change as follows: • Use the chevron switches until the display reads "0033" • Press the RUN/HOLD switch and verify "Cal Done" is displayed	No

Test Codes (continued)

Read Parameters/Values (continued)

Code	Test	Action/Data Displayed	Loop
21	Total Pump Life "On" Time Read/Clear	Read the total pump "on" time, displayed in 10-hour increments. For example, 0037 = 370 hours. To clear the total pump "on" time: • Install a test jumper. See 'Test Connector' for instructions. • Press the CLEAR VOL and PRI/SEC (hidden switch on Model 598) switches until the display shows 0000.	No
22	Total Battery "On" Time Read/Clear	Read the total total time the pump has been running on battery power, displayed in 10-hour increments. For example, 0048 = 480 hours. To clear the total battery "on" time: • Install a test jumper. See 'Test Connector' for instructions. • Press the CLEAR VOL and PRI/SEC (hidden switch on Model 598) switches until the display shows 0000.	No
23	Error/Alarm Stack Read and Clear	Read the last 16 error or alarm codes. The most recent alarm or error is always displayed first. Pressing the  switch displays the previous error/alarm and cycles through the error or alarm codes. ---- denotes the end of the alarm stack. Notes: 1) All error and alarm messages will be displayed in English regardless of the Language Code setting (Test 25). 2) The stack of alarms/error codes will be lost if the battery is removed and the information will be unreliable until filled with new alarm messages or cleared. To clear the alarm stack: • Install a test jumper. See 'Test Connector' for instructions. • Press the CLEAR VOL and PRI/SEC (hidden switch on Model 598) switches until the display reads ----.	No
24	Pressure Calibration Read/Set	See 'Pressure Calibration' section for details of test.	-
25	Language Code Read/Set	See 'Configuration Settings' table on the next page.	-
26	CRIS Configuration	See 'Configuration Settings' table on the next page.	-
27	Air Bubble Length Read	Read the air-in-line alarm threshold value, displayed in microlitres. This value is the nominal air bubble alarm threshold in microlitres used for air-in-line detection and is originally set at the factory.	No
28	FLO Alarm Threshold Read	Read the FLO alarm threshold value in psi. This value is the upstream occlusion alarm threshold pressure in psi and is originally set at the factory.  When upgrading software from V9.xx to V10.05, the flow alarm threshold setting must be changed from 008 to 006. To do this: • Install a test jumper. See 'Test Connector' for instructions. • Change the display to 006 by pressing the chevrons switches. • Press the RUN/HOLD switch. The pump should beep then display CAL DONE followed by t=28. • Turn the pump off/on.	No

Test Codes (continued)

Configuration Settings

Code	Setting	Action	Loop
25	Language Code Read/Set	Read and/or set how error and alarm messages are displayed. E = English text, for example door , Err6 . C = Codes or International, for example, P1 , E1 . For non-English language users. To change the setting, press the PRI/SEC (hidden switch on Model 598) switch and any chevron switch simultaneously for two seconds.	No
26	CRIS Configuration	Setting not in use. CRIS=CRIS enabled, OFF=CRIS disabled. Ensure the setting is OFF .	No
27	Air Bubble Length Read	See 'Read Parameter/Values' table on the previous page.	-
28	FLO Alarm Threshold Read	See 'Read Parameter/Values' table on the previous page.	-
29	Door Calibration Read/Set	See ' Door Calibration ' section for details of test.	-
30	Auxiliary Front Panel Display Enable/Disable	Enable or disable Auxiliary Front Panel Display feature, used to display calibration data. on.05 = feature enabled, where 05 equals the number of times remaining that the pump can be powered on/off with Auxiliary Front Panel Display enabled (five maximum). OFF = feature disabled. To enable the feature: - Press the PRI/SEC (hidden switch on Model 598) switch and any chevron switch simultaneously for two seconds. The display will read on.05. - Turn the pump off then on. The pump is now in normal operating mode with this feature enabled. To disable the feature: - Enter test 30 and press the CLEAR VOL switch. The display will show OFF. Alternatively, turn the pump off/on five times. Warning: Ensure that this feature is OFF before returning the pump into service.	No
31	Secondary Mode Setting On/Off	Enable or disable the Secondary Mode setting (code 35). SC.On = Secondary mode setting enabled (Model 597 only) SC.OF = Secondary mode setting disabled (Model 598) Defaults to SC.On when the EPROM is first installed. If an EPROM is installed on a Model 598, the setting must be changed to SC.OF (secondary off). To change the setting: - Install a test jumper. See 'Test Connector' for instructions. - Load a set segment into the cam follower assembly. - Press the PRI/SEC (hidden switch on Model 598) switch and any chevron switch simultaneously for two seconds.	No
33	Pump Identification Number Read/Set	Read and/or set the pump identification number (ID). To set a new ID, use the chevron switches to select a desired value, then hold the PRI/SEC switch and press the RUN/HOLD switch to exit the test. Press RUN/HOLD again to display and verify the new pump ID.	No

Test Codes (continued)

Configuration Settings (continued)

Code	Setting	Action	Loop
34	Hospital or Alternate Site Configuration Set Note: This setting is unavailable on pumps with software version 10.03 or below.	HOSP = Hospital Configuration ASC = Alternate Site Configuration See Note below. To change the setting: ● Press the PRI/SEC switch and any chevron switch for 2 seconds to toggle the selection. The new configuration choice is displayed. ● Turn off the pump to exit the test and set the new configuration in memory. Note: when set to ASC, note the following: 1) These test codes are not available, and cannot be changed: 25-Language Code set to E=English 26-CRIS setting is OFF=Disabled 30-Auxiliary Front Panel Display feature is OFF=Disabled 31-Secondary Mode Setting is SC.OF = Disabled 2) While the pump is running, the ALL alarm value is 500 microlitres. See test 27. 3) Any previous HOSP configuration values are stored while set to ASC. HOSP values are restored when the HOSP setting is selected again.	No
35	Secondary Mode Enable/Disable (Model 597 only) Note: This setting is unavailable on pumps with software version 10.03 or below.	Read and/or enable or disable Secondary Mode on the Model 597 pump. SC.ON = Secondary mode enabled SC.OF = Secondary mode disabled When software is first installed, this setting may not be enabled when pump is powered on. Ensure the setting is enabled. To change the setting: ● Load a set segment into the cam follower assembly. ● Enter self-test mode and select test code 35. ● Press the RUN/HOLD switch to enter the test. Press the PRI/SEC switch and any chevron switch simultaneously to toggle the selection and select the mode. ● Press the RUN/HOLD switch, then turn the pump off. Note: This setting must be enabled via test code 31.	No
36	Flow Sensor Optional/Mandatory (FSO pumps only*)	Set Flow Sensor usage to optional or mandatory. FS.OP = Use of a flow sensor is optional when running an infusion FS.On = A flow sensor is mandatory (must be fitted) in order to run an infusion To change the setting: ● Install a test jumper. See 'Test Connector' for instructions. ● Press the PRI/SEC switch (the hidden switch on the Model 598) and any chevron switch simultaneously for two seconds. ● Release the switches when the required setting is displayed.  * On non-FSO pumps, when replacing the Logic PCB (139046-100), ensure this setting is changed to FS.OP (flow sensor optional).	No

Test Connector

In order to perform certain tests and to change any pump settings, a test jumper or a low value resistor of 1K5Ω or less, connecting test connector pin 9 to pin 23 must be installed.

Procedure:

1. With the pump off, remove the test connector cover from the back of the rear case.
2. Using a test jumper (part number 134646), a wire, or a low-value resistor (1k5Ω or less), connect pin 9 to pin 23 on the external test connector. See Figure 2-1 below. Take care not to short any pins adjacent to pin 9 or 23 as this may result in a blown fuse.

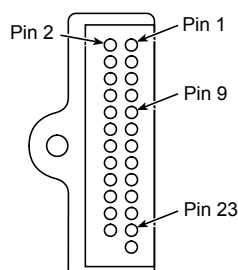


Figure 2-1 External Test Connector (J3)

3. Place the pump in self-test mode then select and carry out the test(s) as required.
4. When the test is complete, remove the test jumper from the test connector.
5. Refit the test connector cover.

Upgrading Software



- **Upgrade of Model 597/598 (FSO) volumetric pump software to V1.10 or greater is recommended when serviced**
- **Upgrade of Model 597/598 (non-FSO) volumetric pump software to V10.03 or greater is recommended when serviced. See 'Notes (non-FSO pumps)' below.**

Perform upgrades by acquiring the software upgrade kits specified in spare parts listings.

Equipment required: Software upgrade kit (includes EPROM fitting and removal instructions)

Software Upgrade Kits Available

Pump Model	Part Number	Software Version
597/598 (FSO)	143053	1.10
597/598 (non-FSO)	136814	10.05

Notes (non-FSO pumps):

- 1) The latest non-FSO software available is V10.05.
- 2) When upgrading software from V9.xx to V10.05, the flow alarm threshold setting must be changed from 008 to 006. See test 28.
- 3) V10.05 software includes test **35** Secondday Mode Enable/Disable (Model 597).
- 4) When replacing the Logic PCB (part number 139046-100) on a non-FSO pump, the latest software is fitted on the PCB. Ensure that test **36** is set to **FS.OP** (flow sensor optional).

Cam Follower Gap Check

Equipment required:

- 0.160" pin gauge (part number 305601), 0.160" block gauge or calibrated calipers
- Indelible marker

Procedure:

1. Open the orange cam follower assembly latch.
2. Position the topmost follower closer to the pressure pad than the other followers. To do this:
Enter self-test mode and select test **08** (alternatively, select test **02**). See 'Entering Self-Test Mode' for instructions. Press the **RUN/HOLD** switch twice within one second to enter the test in loop mode, then press **RUN/HOLD** switch again to exit the loop. Repeat this step until the topmost follower is positioned closest to the pressure pad.
3. Using the pin gauge, check the gap between the pressure pad and the end of the followers (while it is still positioned closest to the pad). See Figure 2-2 below.
4. If the gap measures less than 0.160", check that the Cam Housing Assembly and the Cam Follower Assembly are correctly seated.
5. If the gap *still* measures less than 0.160":
 - replace the Cam Follower Assembly
 - OR, replace the Cam Housing Assembly
 - OR, replace the Front Case

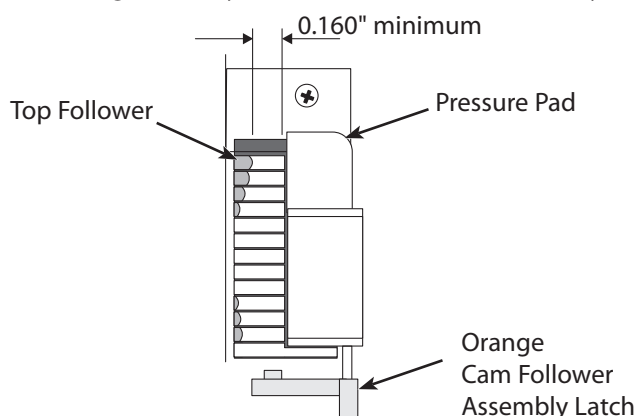


Figure 2-2 Follower/Pressure Pad Gap



IMPORTANT: Failure to maintain the appropriate gap width may result in a set being incorrectly loaded into the pump. If this situation arises, there is a risk that an undetected over-infusion may occur. Refer to MHRA Hazard Notice 2002 (09) for more information.

Functionality Checks

Alarms

Alarm	Action
Door (P1)	Open the door at least ¼ inch. Verify that the pump stops running, an alarm sounds, and the display shows door (P1). Close the door. Press the RUN/HOLD switch momentarily to verify that the alarm stops and the display alternates between the set rate and hold (P3)
FLO (P2)	Set rate to 200 ml/h. Press the RUN/HOLD switch. Verify that the pump starts. Close the set regulating clamp and verify that a FLO (P2) alarm occurs within approximately 15 seconds. Open the set regulating clamp. Note: If you are <i>not</i> using a flow sensor and the pump fails to alarm, perform the 'Pressure Calibration' procedure.
Hold (P3)	Press the RUN/HOLD switch. Verify that the pump starts. Press the RUN/HOLD switch to put pump on hold. Verify audible bleep and hold (P3) alarm displayed after two minutes.
Air (P5)	Load an air-filled IV infusion set (no fluid) into the pump. Press the ON/OFF switch to turn the pump on. Set the rate and the VTBI. Press the RUN/HOLD switch to start the pump. Verify that the pump alarms and displays Air (P5).
Reload ---- Air (P5)	With pump displaying Air (P5)—see above—press RUN/HOLD to put pump on hold, then press the RUN/HOLD switch again and verify that the pump alarms and displays Reload ---- Air (P5) alternating with Air (P5).
Reload (P6)	Start pump <i>without</i> an IV infusion set loaded. Verify that the pump alarms and displays Reload (P6).
OCCL (P7)	Set rate to 200 ml/h. Press the RUN/HOLD switch. Verify that the pump starts. Occlude the set at approximately 2.5 cm from the exit of the pump. Verify an OCCL (P7) alarm occurs within approximately 15 seconds. If the pump fails to alarm, perform the 'Pressure Calibration' procedure. Important: Run the 'Occlusion Verification Test' to verify that the pump occludes between 5.5 and 11 psi (nominal 6 to 8 psi). See below for instructions.
KVO	Set rate to 200 ml/h. Press RUN/HOLD or VTBI . Set VTBI to 0001 ml by pressing the chevron switches. Press RUN/HOLD switch to start pump. Verify that a KVO alarm occurs within approximately 18 seconds.

Verify Volume Infused and Rate Retention

1. Press the **READ VOL** switch and note the infused volume.
2. Press the **ON/OFF** switch to turn pump off. Wait 15 seconds, then press the **ON/OFF** switch again to turn the pump on.
3. Verify the infused volume and the rate displayed are the same as before.

Battery Power Check

1. Remove power cord from the AC power socket.
2. Press the **RUN/HOLD** switch and verify an audible bleep.
3. Verify that the pump operates and the display flashes on and off. Verify that the moving horizontal bars in the left-hand display position are sequencing as before.
4. Plug the power cord back in to AC power socket.

Flow Sensor Check

See ['Physical Inspection and Clean'](#) for instructions.

Occlusion Verification Test

Equipment Set Up:

- Set up equipment as per '[Pressure Calibration Equipment Set Up](#)', with the pressure gauge connected and three-way stopcock closed.

Procedure:

- Set rate to 200 ml/h.
- Press the **RUN/HOLD** switch. Verify that the pump starts.
- Verify that an **OCCL** (P7) alarm between 5.5 and 11 psi (nominal 6 to 8 psi).

If the pump fails to alarm, perform the '[Pressure Calibration](#)' procedure.

Rate Accuracy Verification Test (Code 13)

Equipment Set Up:

- Set up the pump as shown in Figure 2-3 below.
- Close the set roller clamp.
- Plug the pump into AC mains.



Ensure flow sensor is removed.

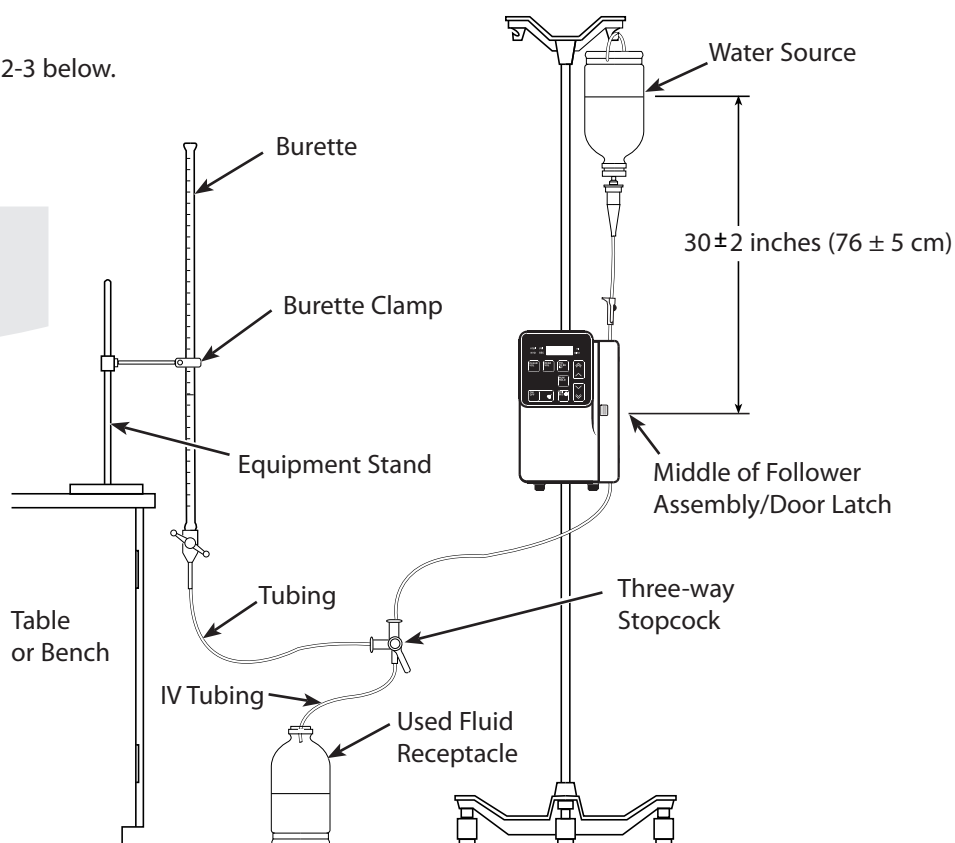


Figure 2-3 Rate Accuracy Verification Test Equipment Set Up

Procedure:

- Using a Class A burette, adjust the fluid level so that the meniscus is level with the zero mark.
- Enter self-test mode and select test **13**. See '[Entering Self-Test Mode](#)' for instructions.
- Press the **RUN/HOLD** switch; the default rate of 300 ml/h will be displayed.
- Press the **RUN/HOLD** switch; the default test time of 300 seconds (5 minutes) will be displayed.
- Press the **RUN/HOLD** switch to start the test. The display will show the test time remaining in seconds. A click will sound as each second is decremented.
- When the display reaches zero seconds, the display shows **STOP** to indicate the end of the test. The **PRI** indicator will also be lit.
- Press the **RUN/HOLD** switch to display the volume infused and verify that the infused volume in the burette is 25 ± 1.25 ml.

Due to variations between IV infusion sets, the reading may not fall within the stated parameters. If this occurs, retest using another IV infusion set. If the variance still exceeds $\pm 5\%$ after retesting with another IV infusion set, replace the Cam Follower Assembly.

Note: During the test run, operational alarms can be cleared by pressing the **RUN/HOLD** switch. The test must be rerun. Error alarms are cleared by turning the pump off and back on. The test must be rerun.

Physical Inspection and Clean

To ensure the pump remains in good operating condition, it is important to keep it clean and carry out the routine procedures described below. All servicing should only be performed by a qualified service engineer.

- ◆ Routinely clean the exterior surface of the pump, the door (including inside surfaces), the integral air-in-line detector, and the cam follower assembly, especially if spillage has occurred.



Before cleaning always switch OFF and disconnect from the AC power supply. Never allow fluid to enter the casing and avoid excess fluid build up on the pump.

Do not use aggressive cleaning agents as these may damage the exterior surface of the pump.

Do not steam autoclave, ethylene oxide sterilise or immerse this pump in any fluid.

- ◆ Unplug the power cord from the AC wall outlet before cleaning. Do not allow fluids to enter the pump case.
- ◆ Use a cloth dampened with warm water, or a mild, non-abrasive detergent (such as commercially available dish cleaning liquid) mixed with water. After cleaning, pumps should be rinsed with a soft cloth soaked in water, followed by a thorough drying. Then apply disinfecting solution with a soft cloth. Rinse using a soft cloth soaked in water after the appropriate disinfecting time, and dry thoroughly. A cotton-tipped applicator is useful for cleaning in narrow spaces.
- ◆ The following cleaning/disinfecting solutions have been evaluated and found to be acceptable:

- Cidex	- Glutarex
- Hydrogen Peroxide (3% in water)	- Manu-Klenz
- T.B.Q	- Insurance
- Vesphene	

Note: Alcohol, ammonia, acetone, benzene, phosphoric acid, xylene, and similar solvents can erode (wear away pit) or otherwise damage the cam followers and other surfaces of the pump. The cam followers must be kept clean using a solution of warm water and a mild non-abrasive detergent, and inspected for possible erosion. The cam follower assembly should be removed and cleaned according to the procedure outlined below, see '[Clean and Inspect the Cam Follower Assembly](#)'.

- ◆ Check that labels are flat, legible and fully adhered. Replace as necessary.
- ◆ Inspect case components for damage and replace if necessary.
- ◆ Inspect the door for damage and check that it closes and latches correctly.
- ◆ Check door magnet is in place. Replace if necessary.
- ◆ Inspect the AC power supply plug and cable for damage.

Physical Inspection and Clean *(continued)*

- ◆ Verify the cam follower assembly latch opens and closes properly.



It is important to clean the cam follower assembly after fluid spills and during routine inspections. Spilled fluid left to dry may lead to FLO (P2), OCCL (P7) or Err n (En) alarms, or may cause a free-flow condition. Do not use the pump under this condition. Remove the cam follower assembly and clean as described below.

- ◆ Inspect cam follower housing parts for fluid spill residue or foreign matter. If residue is noted in the cam follower assembly, refer to the cleaning instructions for the appropriate method for removing and cleaning.

The Cam Follower Assembly

◆ Inspect the Followers for Erosion

Shine a flashlight into the followers. The followers should be clean and shiny. A dull appearance may indicate erosion. If the followers appear dirty or dull, remove and clean per the following procedure.

◆ Remove the Cam Follower Assembly from the Pump

See 'Cam Follower Assembly' in Chapter 5, 'Spare Parts Replacement Procedures' for instructions.

◆ Clean and Inspect the Cam Follower Assembly

1. Soak the cam follower assembly for 10 minutes in a warm, mild detergent solution. Commercially available dish cleaning liquid is acceptable. Clean the surface of the followers using a cotton-tipped applicator.
2. Rinse the cam follower assembly well under running water.
3. Allow the cam follower assembly to dry thoroughly.
4. When dry, verify that the latch and all the followers of the cam follower assembly move freely, especially the pressure-sensing follower.
5. If the followers do not move freely, repeat the soak, rinse, and dry process.
6. Check the cam followers for erosion. The followers should be clean and shiny. A dull appearance may indicate erosion. If they are still dull after cleaning, replace the Cam Follower Assembly as described in Chapter 5, ['Spare Parts Replacement Procedures'](#).
7. Examine the gasket on the front case. Clean or replace as needed.

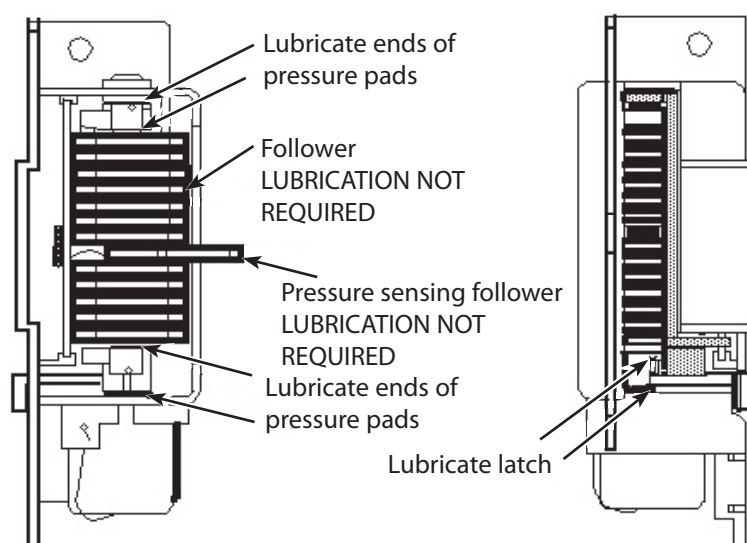


Figure 2-4 Lubricating the Cam Follower Assembly

◆ Lubricate the Cam Follower Assembly

1. Lubricate the cam follower assembly with a light consistency of silicone based lubricating grease (part number 0000ME00388), or equivalent.

Physical Inspection and Clean *(continued)*

2. Apply lubricant to both sides of both ends of the pressure pads, and both sides of the cam follower assembly latch, as shown in Figure 2-4 below.

◆ Re-fit the Cam Follower Assembly

Re-fit the cam follower assembly into the pump following the instructions in the section 'Cam Follower Assembly' in Chapter 5, '[Spare Parts Replacement Procedures](#)'.

The Cam Follower Assembly *(continued)*

◆ Placement Check: Run Test 08

1. Enter self-test mode and select test **08**. Press the **RUN/HOLD** switch twice to run the test in loop mode.
2. If there is excessive noise, loosen retaining screws as required and adjust the cam follower assembly as far as possible towards the bottom of the pump.
3. Tighten retaining screws then press the **ON/OFF** switch to turn the pump off.

Flow Sensor Check (FSO model only)

- ◆ Wash the flow sensor with warm water to dissolve and remove any dried IV solution that may cloud the lenses or prevent the sliding parts from operating smoothly.
- ◆ Check that labels are flat, legible and fully adhered. Replace as necessary.
- ◆ Check that lenses are clean and clear, and show no signs of cracks.
- ◆ Inspect the body of the flow sensor for signs of physical damage.
- ◆ Check that the sliding action of the flow sensor operates smoothly.

Calibration Procedures

Door Calibration (Code 29)



Perform this procedure whenever the Door Assembly, Magnet, Cam Housing Assembly, Optical Sensor Board, Logic Board, or EEPROM have been replaced.

Equipment required: 0.125" (3.175mm) pin gauge

Procedure:

1. Install a test jumper. See 'Test Connector' for instructions.
2. Enter self-test mode and select test **29**.
3. Open the door and rest a 0.125" (3.175mm) pin gauge on top of the door latch. See Figure 2-5. Close the door and hold it closed at the location across from the latch.
4. Press the **PRI/SEC** (hidden switch on the Model 598) and **RUN/HOLD** switches simultaneously. The pump will beep twice and display **CAL DONE**.

Note: To read the calibration number, press the **READ VOL** switch.

5. Open the door and remove the gauge.
6. Remove the test connector jumper and refit the test connector cover.

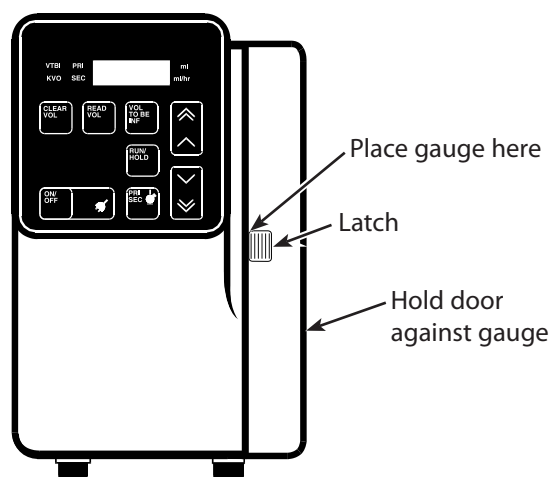


Figure 2-5 Door Calibration

To verify the door sensor is correctly calibrated, run test 11, Door Sensor Test.



Calibration Procedures *(continued)*

Pressure Calibration

The following procedure describes how to calibrate the pressure sensor. Two pressure calibration values are read/set in test **24**, these are:

- Pressure Slope is expressed in psi/volts, range is 9.0 to 51.0. Values can be changed in 0.1 increments, however, the pump only retains values in 0.2 increments. The pressure slope value affects both upstream and downstream pressure readings.
- Pressure Offset is used to correct for a non-zero pressure reading when the actual downstream pressure is zero. This calibration value is expressed in psi + 10.0 with a range of entered values from 5.0 to 15.0 which correspond to actual offset values from -5.0 to +5.0. The pressure offset value affects the downstream pressure reading only.

Summary

Stage 1: Set up equipment

Stage 2: Read and compare downstream pressure values

- ◆ Set up auxiliary front panel displays (test **30**)
- ◆ Measure (read and record) downstream pressure with zero pressure, for example P0 = -0.8
- ◆ Measure (read and record) downstream pressure with 8 psi, for example P8 = 4.8
- ◆ Examine P0 and P8 readings. Continue to Stage 3 if readings are not within +/- 1.2 psi.

Stage 3: Measure initial pressure calibration values - pressure slope/pressure offset (code 24)

Stage 4: Calculate new pressure calibration values

Stage 5: Program pump with two new pressure calibration values (test **24**)

Stage 1: Set up equipment

Set up the equipment as shown in Figure 2-6 below.

- The vertical distance (from the fluid level of the container to the centre of the cam follower assembly) of 30 ± 2 inches must be maintained because the height of the solution container will affect the pressure readings
- Ensure that the IV infusion set is completely primed with fluid (no air) before attaching to reservoir
- Ensure that the IV infusion set loaded in the pump and any tubing used in the set up is not kinked
- Ensure that fittings are secure and reservoir is airtight



DECV sets are not to be used to perform pressure calibration.

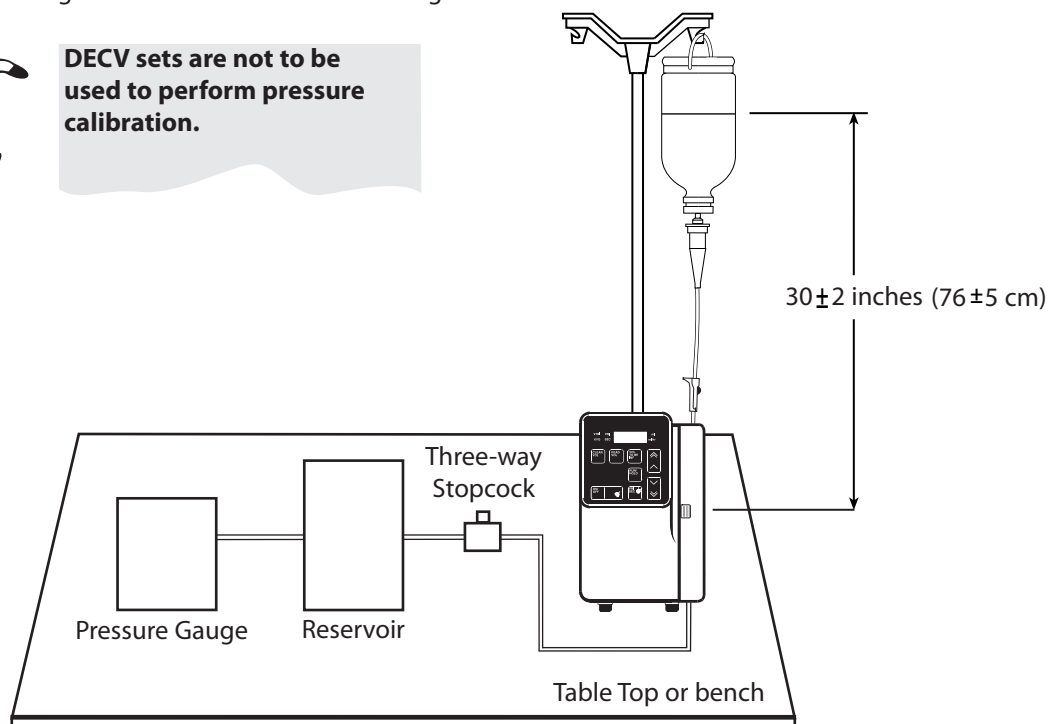


Figure 2-6 Pressure Calibration Equipment Set Up

Calibration Procedures *(continued)*

Pressure Calibration *(continued)*

Stage 2: Read and compare downstream pressure values

1. Enter self-test mode and select self-test 30 (set up auxiliary front panel displays). See 'Entering Self-Test Mode' for instructions.
2. Press any chevron switch and the **PRI/SEC** (hidden switch on Model 598) switch simultaneously until **on05** is displayed.
3. Turn pump off and on. Open the three-way stopcock.
4. Set the rate to 200 ml/h. Clear the volume infused, and set the volume to be infused to 500 ml.
5. Start the pump running.
6. Press the **READ VOL** and  switches simultaneously to enable Pressure Read mode.

Notes:

- The display should read **Pres 06** (indicating that the flow alarm threshold value is set to 006 in test **28**).
 - Pressure Read mode will stay enabled until **RUN/HOLD** is pressed.
7. Press the  and  switches simultaneously to disable occlusion alarms OCCL and FLO. The pump will display **FLO OFF, OCCL OFF**, and will beep three times. Note: FLO and OCCL alarms are automatically enabled at the next power-up.
 8. After 30 seconds, press the  switch to display the downstream pressure. Record this downstream pressure reading as P0. Note that it may be a negative number. For example, P0 = -0.8.
 9. Connect the pump to the pressure gauge by closing the three-way stopcock. When the pressure gauge reads $8 \pm .25$ psi record this downstream pressure reading as P8.
 10. Examine the pressure readings recorded in Step 8 and Step 9. If they are $P0 = 0 \pm 1.2$ psi and $P8 = 8 \pm 1.2$ psi, then the pressure calibration is complete. If not, turn the pump off and then perform Steps 11 through 18.

Stage 3: Measure initial pressure calibration values - pressure slope/pressure offset

11. Enter self-test mode and select test **24**. See 'Entering Self-Test Mode' for instructions.
12. Read and record the initial pressure slope value displayed on entering test **24**. Press **RUN/HOLD** to display the initial pressure offset value. Record this value. These values will be used in the next stage (Stage 4) to calculate the new pressure calibration values.

Calibration Procedures *(continued)*

13. Press **RUN/HOLD** to exit the test.

Pressure Calibration *(continued)*

Stage 4: Calculate new pressure calibration values

14. Calculate the two new pressure calibration values as follows, rounding results to the nearest 0.1:

Calculation Formula			
New pressure slope (psi/volts)	=	$\frac{\text{Initial pressure slope} \times 8}{P8 - P0}$	
New pressure offset (psi/volts)	=	$\text{Initial pressure offset} - \frac{P0 \times 8}{P8 - P0}$	

Example Formula			
New pressure slope	=	$\frac{25 \times 8}{4.8 - (-0.8)}$	= $\frac{200}{5.6} = 35.7$
New pressure offset	=	$11 - \frac{-0.8 \times 8}{4.8 - (-0.8)}$	= $11 - \frac{-6.4}{5.6} = 11 - (-1.14) = 11 + 1.14 = 12.1$
Where:			
Initial pressure slope (Step 12)	=	25.0	
Initial pressure offset (Step 12)	=	11.0	
Measured P0 (Step 8)	=	-0.8	
Measured P8 (Step 9)	=	4.8	

Stage 5: Program pump with two new pressure calibration values (code 24)

15. Install a test jumper. See 'Test Connector' for instructions.

16. Enter self-test mode and select test **24**. See 'Entering Self-Test Mode' for instructions.

17. Enter the new pressure slope value calculated in Step 14. Press **PRI/SEC** (hidden switch on Model 598) and the **RUN/HOLD** switches simultaneously. Verify a beep and a display of **Cal done**.

Now enter the new pressure offset value calculated in Step 14. Press **PRI/SEC** (hidden switch on Model 598) and the **RUN/HOLD** switches simultaneously. Verify a beep and a display of **Cal done**.

18. Repeat Steps 3 through Step 10.



If more than five power-on cycles are required during the procedure, repeat Steps 1 and 2 to re-enable auxiliary front panel displays.

Performance Verification Procedure

Model / Serial Number:		Service Order / Inventory Number:		
Hospital Name / Reference:		Software Version:		
Inspection	Physical inspection and clean CH2			
Updates	Recommended when serviced	UPDATE REF:	Fitted ✓	Not fitted / Not Applicable ✓
	Non FSO pumps: Update software to v10.03 or greater (136814)	TSM CH2		
	FSO pumps: Update software to v1.10 (143053)	TSM CH2		
	Full length door label (141565 - English)	TSM CH5		
INSPECTION	Check cam follower gap with pin gauge CH2			
Self Test ^{CH2}	Check all functions in self-test			
	Check pressure calibration values (re-calibrate as required - self-tests 30 and 24) P0 = 0 psi ± 1.2 P8 = 8 psi ± 1.2			
Infusing	During standard infusion check the following: Start up sequence VTBI and rate retention KVO operation Flow Sensor option if FSO model			
	Alarms functionality check CH2 Door (P1), FLO (P2), hold (P3), AIL (P5), RELOAD AIR (P5...P6), RELOAD (P6), OCCL (P7), KVO, Time Out. Ensure pump works on battery and AC mains			
Verification Tests ^{CH2}	Rate accuracy test (Automatic test in self-test 13) Pump set to 300 ml/h for 300 seconds, volume infused = 23.75 to 26.25 ml	_____ ml		
	Occlusion tests Pump Infusing 200ml/h, OCCL is between 5.5 to 11 psi (nominal 6 to 8 psi)	_____ psi		
Setup	Set rate to zero (or lowest value possible), Clear Volume Infused and VTBI Clear Error / Alarm / Battery logs (as required)			
Electrical Safety Tests	Class I Type CF Test in accordance with the standard EN 60601-1 and test equipment operation manual.	Test results are stored: Electronically ☐ Print-out ☐ Other ☐ _____	PASS / FAIL	
Verification Performed By	_____ Sign	_____ Print	_____ Date	
CHX indicates the chapter number in the Technical Service Manual (TSM) - 1000SM00016. E.G. CH2 = Refer to TSM Chapter 2.				

Troubleshooting

In this chapter

Introduction	32
Error Messages	32
General Fault Diagnosis	36

Introduction

Use this troubleshooting guide to help identify the cause of errors and faults which may occur as a result of damage to the pump or failure of an internal component. The following table lists the error messages (and corresponding codes) and describes what action to take to resolve the problem. A general fault diagnosis checklist is also provided. For information on alarm procedures and messages, refer to the relevant *DFU*.

Note: The configuration setting in test **25** determines whether messages are displayed as text or as codes.



If the nature of the problem is unclear, enter self-test mode and step through test 00 to check that the main functions of the pump are operating correctly. See Chapter 2, 'Routine Maintenance & Calibration' for details.

Test 23 ERROR/ALARM STACK READ/CLEAR displays the sixteen most recent malfunction codes. To run test 23, enter self-test mode and select the test. See Chapter 2 for instructions.

Error Messages

Message	Code	Failure	Action/Replace
Air	P5	Air in tubing detected by air-in-line sensor. IV infusion set adapter dislodged from air-in-line sensor	Purge air from infusion set. Check air-in-line sensor is clean. Check IV infusion set is properly installed in air-in-line sensor.
Reload ---- Air alternating with Air	P5	Air in tubing detected by air-in-line sensor. IV infusion set adapter dislodged from air-in-line sensor.	Purge air from infusion set.
Reload	P6	Set adapter improperly loaded into air-in-line sensor.	Reload IV infusion set into air-in-line sensor, pressing firmly until adapter is flush.
bat. beeps 3 times every 2 minutes (alternating with delivery rate; pump continues to run)	H2	Low battery alert. Battery has one hour or less of usable charge remaining.	Plug into AC mains. Note: Recharge time with pump off is approximately 24 hours from discharge to 100%.
batt. audible alarm	P4	Battery has insufficient charge to operate pump.	 Batteries should be given a full 24 hour charge when replaced, when pump is to be stored for an extended period of more than 3 weeks and upon receipt of a new pump.
bat. or batt. persistent alarm after charging	H2/P4	Weak battery or battery charge circuit out of adjustment/malfunctioning Power Regulator Board circuitry problem	
door	P1	Door open. Magnet/door assembly out of calibration, magnet broken, misaligned or missing. Optical Sensor PCB malfunction/failure. Wiring harness open or shorted. Logic PCB failure.	Check IV infusion set is properly installed. Close door and restart pump. If error persists: Verify door calibration and recalibrate as necessary. Check door magnet. If loose, check polarization and reinstall or replace. Check Optical Sensor PCB. Move sensor toward magnet if required. Replace Optical Sensor PCB. See tests 11 and 29 and run as necessary. Check cable wiring/connections and repair/replace. Replace Logic PCB.
FLO	P2	Upstream occlusion. Dried spillage in mechanism	Check tubing, clamp and container. Remove and clean mechanism.
FLO.1	P2	Too few or no drops detected	Check for empty container, closed or partially closed clamp, clogged filter, occluded/kinked tubing.

Error Messages (continued)

Message	Code	Failure	Action/Replace
FLO.2	P2	Abnormal drops detected. Fogging or droplets on sidewalls of drip chamber. Drip chamber overfilled or splashing of fluid caused by excessive movement of drip chamber (as in transport of patient). Clamp not fully open. Flow sensor not plugged in or disconnected while operating; optical path obstructed. Test 36 (Flow Sensor configuration setting) is set to FS.On so pump expects to detect a flow sensor. Incorrect (non-FSO) rear case fitted.	Shake drip chamber to clear sidewalls. If alarm persists, replace IV infusion set. Reduce level of fluid in drip chamber. Check clamp is fully open. Check flow sensor is plugged into back of pump, optical path is not obstructed; verify position of flow sensor on drip chamber. Change configuration setting from FS.On (mandatory) to FS.off (optional) via test 36. Verify rear case.
FLO.3	P2	Flow detected in excess of set rate.	Check tubing is completely installed in mechanism and that the mechanism pinches off the tubing.
hold <i>alternating with rate; no audible alarm</i>	H1	Pump has been placed on hold.	Press the RUN/HOLD switch once to restart the pump.
hold <i>flashing display; audible alarm</i>	P3	2 minutes has elapsed since pump put on hold or since last switch was pressed in start-up mode. A switch has stuck or shorted for 2 minutes while the pump was running.	Press the RUN/HOLD switch once to silence the alarm, and again to restart pump. To restart the 2-minute timer, press any front panel switch or open the door. If alarm repeats in 2 minutes, run test 14. Note: If alarm occurs in start-up mode with pump on battery power, pump will turn off if left in alarm for 3 minutes.
OCCL	P7	Downstream occlusion. Dried spillage in the mechanism.	Check for kinked tubing, clogged filter. Remove and clean mechanism. If error persists, perform Pressure Calibration procedure. Also run the 'Occlusion Verification Test'.
Err.1	E1	Display Board PCB problem (Display segment error). Open or shorted Display LED. Display cable problem. Logic PCB circuitry problem. Pressure amp cable misaligned. Short on Pressure Amp PCB.	Replace Display Board PCB. Run test 6, test 17 or test 3. Replace Display cable harness. Replace Logic PCB. Check pressure amp cable connections. Replace Follower Housing Assembly.
Err.2	E2	Logic PCB component malfunction (rate error).	Replace Logic PCB.
Err.3	E3	Speaker disconnected or malfunctioning; speaker driver malfunction.	Check speaker connections. Replace Speaker. Replace Power Regulator PCB.
Err.4	E4	Watchdog malfunction. Logic PCB circuitry malfunction.	Replace Power Regulator PCB. Replace Logic PCB.
Err.5	E5	Motor drive on Power Regulator PCB disabled. Interconnect cable problem. Watchdog alarm failure on Logic PCB	Replace Power Regulator PCB. Replace cable connecting Power Regulator PCB and Logic PCB. Replace Logic PCB.
Err.6	E6	EEPROM blank due to replacement, (calibration error).	Recalibrate before returning for patient use. Perform 'Door Calibration Procedure' and 'Pressure Calibration Procedure'.

Troubleshooting

Error Messages (continued)

Message	Code	Failure	Action/Replace
Err.7	E7	Logic PCB component failure (ROM data error)	Replace Logic PCB.
Err.8	E8	Logic PCB (RAM failure or low VRAM voltage)	Replace Logic PCB.
Err.11	E11	Logic PCB component failure (calculation error)	Replace Logic PCB.
Err.a	Ea	Volume or tack flag error.	Check that the encoder disk in the CAM Housing Assembly is not loose. Replace Optical Sensor PCB. Run test 08 . See also Err.h.
Err.A	EA	Logic PCB component failure (software error).	Replace Logic PCB.
Err.b	Eb		
Err.C	EC	Door sensor error. Logic PCB signal malfunction.	Run test 11 . Replace Logic PCB.
Err.d	Ed	Logic PCB problem (CPU error).	Replace Logic PCB.
Err.e	Ee	Motor too fast. Motor drive circuit failure.	Run test 02 and test 05 . Replace mechanism. Replace Power Regulator PCB. Replace Logic PCB. See also Err.n.
Err.E	EE	Watchdog malfunction error. Watchdog alarm (WDAL) does not activate.	Replace Logic PCB.
Err.F	EF	Foreground overrun error. Logic PCB component failure.	
Err.h	Eh	Motor too slow. Mechanism sticking or have high friction.	Run test 02 and test 05 . Replace mechanism. Replace Power Regulator PCB. Replace Logic PCB.
Err.H	EH	Motor stall at power- up. Motor open or disconnected.	Run test 02 and test 05 . Replace mechanism. Replace Power Regulator PCB. Replace Logic PCB.
Err.J	EJ	Air-in-line electronics. Air-in-line frequency (R22) on Power Regulator Board misadjusted.	Run test 04 . Verify correct air-in-line frequency and adjust if necessary. See procedure below. Replace Power Regulator PCB.
Err.L	EL	Logic PCB circuitry or A/D converter malfunction (ADC error). Weak battery (if error only occurs on switching to battery power).	Replace Logic PCB. Charge battery. Note: Recharge time with pump off is approximately 24 hours from discharge to 100%. Measure battery voltage. If less than 6.0V replace battery. If error persists after charging then suspect weak battery or battery charge circuit out of adjustment/ malfunction: Check mains outlet power, verify battery charge voltage is 7.02 ± 0.05 VDC (see procedure below). If error still persists, replace battery, replace Power Regulator PCB.
Err.n	En	Dried spillage in mechanism. Misaligned Follower Housing Assembly. Induced electrical noise in pressure signal.	Remove and clean mechanism. Check Pressure amp cable connections. Check that Pressure amp connector and Follower Housing Assembly are free of moisture. Check for sources of external EMI, RFI, ESD noise.

Error Messages (continued)

Message	Code	Failure	Action/Replace
Err.o	Eo	Start-up or CPU running tests failed. Logic PCB failure.	Replace Logic PCB.
Err.P	EP	EEPROM read/write error (calibration error).	Run test 19 . Replace EEPROM.
Err.u	Eu	Pressure sensor electronics error.	Run test 03 . Check cable into Follower Housing Assembly is securely connected, is not pinched, cut or has solution contamination. Clean mechanism. If error persists, replace Follower Housing Assembly.
Err.U	EU	Pressure sensor software error.	Check that the encoder disk in the CAM Housing Assembly is not loose. Replace Optical Sensor PCB. Run test 08 . See also Err.h.
Err.Y	EY	Battery error. Battery charger circuit malfunction/failure.	Charge battery. Note: Recharge time with pump off is approximately 24 hours from discharge to 100%. Measure battery voltage. If less than 6.0V replace battery. Replace fuse(s). Replace fuse on Power Regulator PCB. If error persists after charging then suspect weak battery or battery charge circuit out of adjustment/malfunction: Check mains outlet power, verify battery charge voltage is $7.02 \pm .05$ VDC (see procedure below). If error still persists, replace battery, replace Power Regulator PCB.

Battery Charge Circuit Voltage Test (bat. batt. or Err Y)

Equipment required: Test cable (135740), Digital volt meter.

1. Connect the Test cable to the digital volt meter, red to (+) and black to (-). Ensure the meter is set to the DC voltage setting. Set the meter to the 20 volt range.
2. Disconnect the battery from the pump.
3. Connect the Test cable to the battery connector (J3) on the Power Regulator PCB.
4. Connect the pump to AC mains. If the pump turns on, turn the pump off.
5. With the pump off, check that the voltage reading 7.02 ± 0.05 VDC (6.97 to 7.07 volts). If not, adjust R53 accordingly and reseal.
6. Disconnect the pump from AC mains. Disconnect the Test cable and reconnect the battery.

Air-in-line Frequency Test (Err J)

Equipment required: Frequency counter cable

1. Connect the frequency counter cable to the test connector (J6) on the Power Regulator PCB. Note: pin 2 is GND, pin 1 is signal.
2. Turn the pump on.
3. Check that the frequency value is 3.3 ± 0.1 MHz. If not, adjust R22 accordingly and reseal.

General Fault Diagnosis

Parts to Check/Test

Fault	Front Case	Rear Case	Labels	Mechanism	CAM Follower Assembly	Logic PCB	Power Regulator Board	Display PCB	Battery	Mains Lead	Fuses	Transformer
Dropped or damaged	✓	✓		✓		✓	✓	✓				
Exposed to fluids	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
No battery power							✓		✓		✓	
No AC mains power							✓			✓	✓	✓
Delivery rates out of tolerance	✓			✓	✓	✓						
Scrambled or frozen Display						✓		✓	✓			
No Display				✓		✓	✓	✓	✓		✓	
Fuse(s) blown							✓			✓	✓	✓



Low audio problem

If the audio transducer installed is a sealed part, ensure that it has been installed with its lead polarities opposite to that indicated on the Power Regulator Board assembly.

If the audio transducer installed is an unsealed part, ensure that it has been installed with its lead polarities matching that indicated on the Power Regulator Board assembly.

Chapter 4

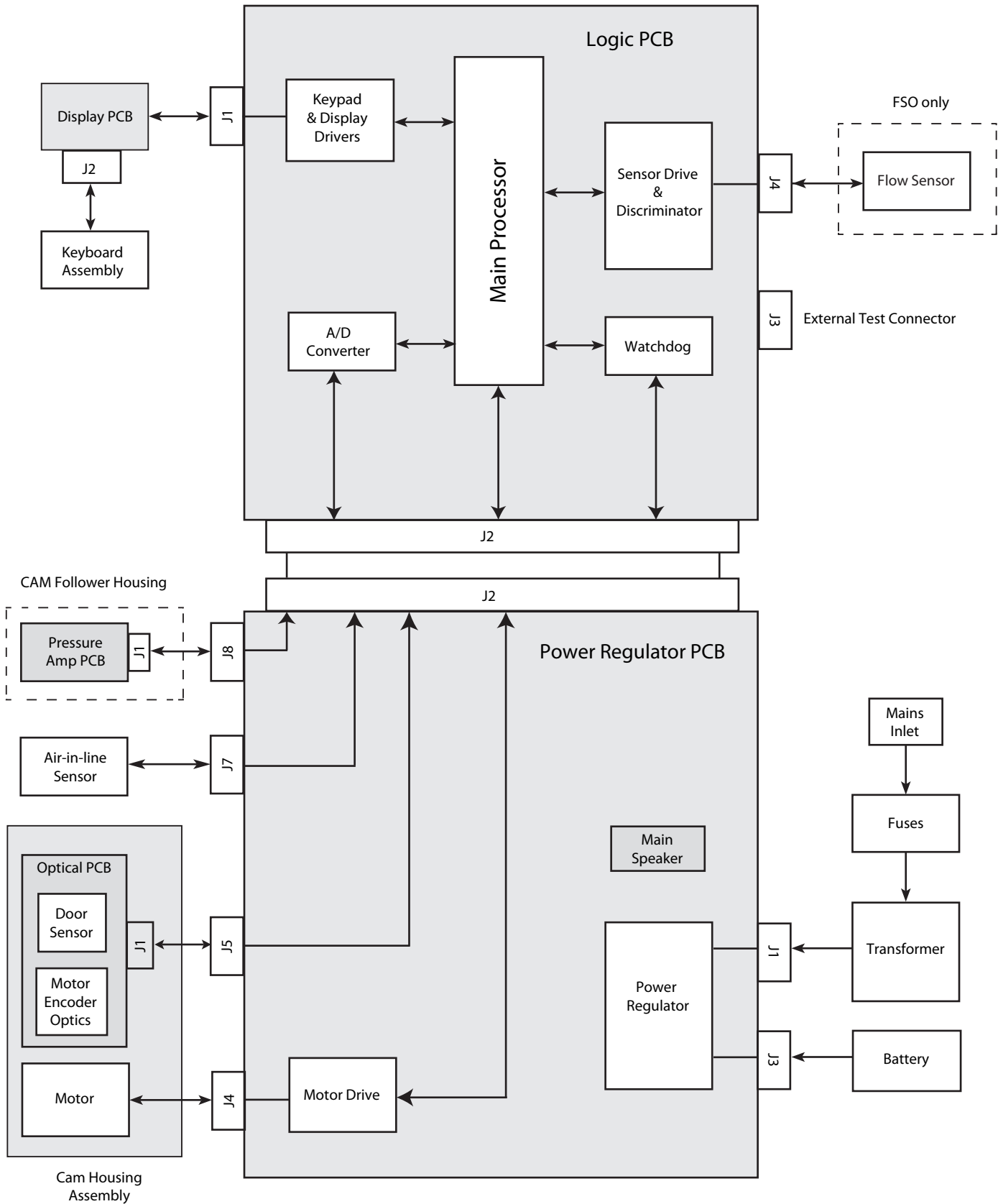
Circuit Descriptions

In this chapter

Functional Module Block Diagram	35
Module Overview Functional Description	36

Functional Module Block Diagram

IVAC® Volumetric Pump (Models 597 & 598)



Module Overview Functional Description

The IVAC® Volumetric Pumps (Models 597 & 598) are designed to be serviced generally to major assembly level.

The circuitry within the pump is contained on five printed circuit boards (PCBs): Logic PCB, Pressure Amplifier PCB, Display PCB, Optical Sensor PCB and Power Regulator PCB.

CareFusion will make available, on request, circuit diagrams which will assist appropriately qualified technical personnel to repair those parts of the device which are designated by the manufacturer as repairable.

Logic PCB

Contains the main processor module, watchdog circuitry and RAM which provide the control functions for almost all the aspects of the pump. It drives and monitors all other modules using the program code stored in the EPROM.

- **On/Off Switch**
The On/Off switch enables power to the system. It uses a single push button on the front panel to toggle the "D" type flip flop (U16). Note U16 is always powered if a charged battery is connected to the pump.
- **Main Processor**
Consists of an 8-bit microcontroller and internal A to D converter. The processor gets instructions from the program memory (U5) and then executes them. The main processor controls almost all of the functions of the pump, such as external communications, motor, flow sensor, read and write to the memory, all interrupts switches, air in line status, front display and alarm tests.
- **Watchdog**
The watchdog IC (U3) consists of a custom CMOS gate array which contains the watchdog CPU circuit, the audio signal generator, the address decoding circuit, four output lines, the flow sensor control clock signals, and a 12-bit interrupt timer. The purpose of the watchdog circuit is to generate a latched alarm signal and turn on the audio output if the main processor does not reset the circuit within a defined time window from the previous circuit reset.
- **A/D Converter**
The A to D converter digitises the pressure signal and the flow detector output, door latch sensor, battery and power voltages and monitor's the status of the mechanism circuit.
- **Flow Sensor**
The drop sensor drive and discriminator circuits provide drop signal processing, ambient light rejection, and closed loop gain for the drop sensor. The flow sensor LED emitter and photo detector are located in the pump's optional flow sensor.

Power Regulator PCB

The Power Regulator module provides system DC voltages, AC line and battery charging functions, air in line sensing circuitry, mechanism drive and speaker drive.

- **Instrument Power Supplies**
The system's DC voltages are as follows;
 - ◆ +V Supply: when activated the +V supply provides power to the +2.5V and VREF signal lines.
 - ◆ +5V Supply: provides power to the system logic.
 - ◆ VRAM: the +5V supply provides the VRAM supply which keeps the logic RAM powered all the time.
 - ◆ VREF: the reference voltage circuit provide the A to D converter with a stable accurate voltage.
 - ◆ VB: low battery detection is accomplished by the main processor through the A to D converter.
- **AC Line and Battery Supply**
The AC line and battery supply circuit provides regulated, current limited charging power to the battery using a linear regulation technique. The current is limited to 700mA and the voltage is sustained at about 7.02V when attached to the mains.
- **Audio Drive Circuit**
Provides the interface between the main processor controlled AUDIO signal and a speaker, along with a means to sense whether the speaker is operating.

Module Overview Functional Description *(continued)*

Power Regulator PCB (continued)

- **Mechanism Drive and Sense**

The mechanism driver circuit provides the interface between the mechanism drive signal from the main processor and flow control mechanism. The SAFETY signal is required to be HIGH and the MECH signal is required to be LOW for the mechanism to work. If this is not the case the CAM followers will remain stationary.

- **Air-In-Line Detect Circuitry**

The air-in-line circuitry drives the ultrasonic transducers (contained within the Follower Housing assembly) through a range of frequencies to ensure that the transducers are driven at their resonant frequency. The range of ultrasonic frequencies will travel through solid or liquid, but not air. The receiver signal goes through the signal processing circuitry on the Power Regulator PCB, and if the signal is above the threshold of 845mV then a pulse is provided from U3. Presence of air in the set will result in no pulse from U3. (i.e. below the threshold voltage)

Pressure Sense System and Amplifier PCB

The pressure sensing system detects upstream and downstream occlusions. Pressure is measured through the wall of the silicon segment of the IV administration set by a non-pumping cam follower fitted with a strain gauge. The pressure amplifier is used to condition the signal from the strain gauge for the A to D converter.

Display Assembly

Comprises a Display PCB and a switch matrix (keyboard). The Display PCB consists of seven-segment LEDs, bar LEDs and FET drivers, as well as a connection interface for the switch matrix. The display assembly enables user interface functionality and a display of the current pump status, for example, infusion volume and rate.

Optical Sensor PCB

Comprises two main elements:

- **Door Detect Sensor**

The door detect sensor is a Hall effect sensor that detects the presence of the magnet contained within the door assembly.

- **Motor Encoder Optics**

The motor encoders consist of a transmitter and a receiver. The receiver passes the pulsed signal back to the Logic PCB for processing.

Battery

The sealed Lead Acid battery pack consists of 3 cells, each with a potential between 1.8V to 2.4V per cell. The battery pack is rated at 3.4Ah and 6VDC.

Transformer, Mains Inlet and Fuses

The mains inlet provides the transformer 240V AC (UK) to the primary winding of the transformer. The transformer through a winding ratio steps down the voltage which is then rectified and filtered to provide an unregulated VBRIDGE voltage of 7.5 volts to 17 volts dependent on AC line loading. Two fuses are in circuit to provide current protection. A 1.5A fuse is also fitted to the Power Regulator PCB for additional protection.

Spare Parts Replacement Procedures

In this chapter

Separating the Front and Rear Cases	39
Front Case	41
Cam Follower Assembly, Air-In-Line Sensor	41
Door Assembly, Magnet	42
Cam Housing Assembly	43
Battery	44
Mounting Nut	44
Transformer	44
Door Strike Plate	44
Display Board, Keyboard Assembly	46
Rear Case	47
Logic Board, Power Regulator Board	47
Fuse Holders	49
Mains Inlet Assembly	49
Pole Clamp	50
Labels	51

Separating the Front and Rear Cases



- Ensure the pump is disconnected from the AC power supply and switched off before attempting to service the pump
- The pump contains static-sensitive components. Observe strict ESD precautions at all times
- Batteries should be disposed of as outlined by the local country regulations: do not send back to the manufacturer
- For fastener torque settings, refer to Appendix C, '[Fitting & Replacement Guidelines](#)'
- Only use CareFusion recommended spare parts
- Following all spare part replacement and repair activities, testing must be performed in accordance with the Performance Verification Procedure (PVP), see Chapter 2, '[Routine Maintenance & Calibration](#)'.

Replacement Procedure

1. Remove the four corner screws located on the back of the rear case.
2. Carefully separate the two sections of the case. **Note:** The door hinge pins may fall out at this time. Take care not to lose them.
3. Unplug the battery connector from the Power Regulator Board (at J3).



- Disconnecting the battery will erase operator settings and the alarm stack. Calibration settings will not be affected
- When reconnecting the battery, the pump may switch on. If so, press the ON/OFF switch on front panel

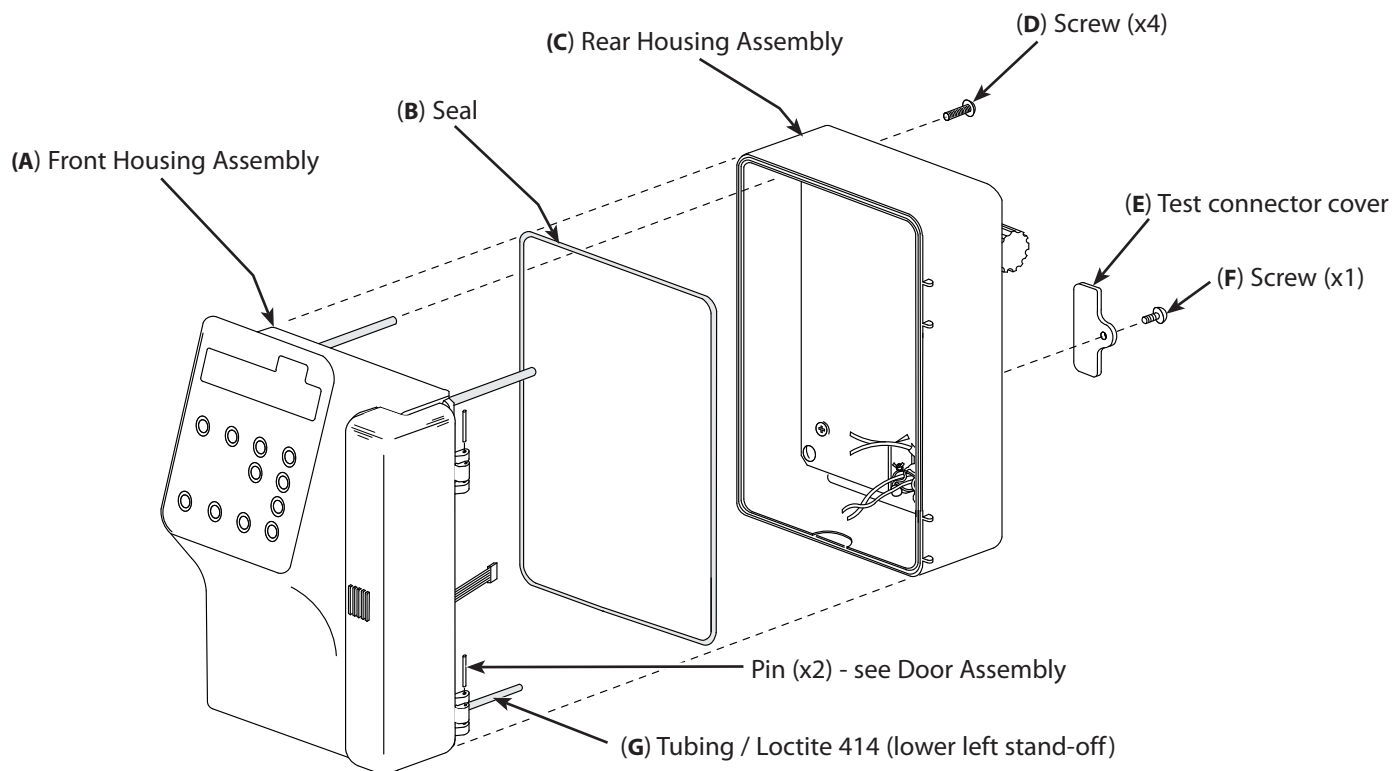
4. Detach harness connections as required:
 - ◆ Remove the two tie wraps securing wires near battery and at wire ends. Remove the two tie wraps (at top of front housing and near wire ends) securing the black and brown transformer wires and the green/yellow ground cable.
 - ◆ Pull out the ground wire and transformer wires routed next to the battery and under the motor.
 - ◆ Remove the 7-pin ribbon cable from the Cam Follower Housing (connecting to the Power Regulator Board, at J8).
 - ◆ Remove the 10-pin ribbon cable connecting the Optical Sensor Board to the Power Regulator Board (at J5).
 - ◆ Unplug the 6-pin Air-In-Line Sensor connector from the Power Regulator Board (at J7).
 - ◆ Unplug the 2-pin Transformer connector from the Power Regulator Board (at J1).
 - ◆ Disconnect the 26-pin Display cable from the Logic Board (at J1).
 - ◆ Unplug the 8-pin motor connector cable from the Power Regulator Board (at J4).
5. Reassemble in reverse order.

Refitting notes:

- 1) The longest stand-off is sited into the bottom right corner of the front housing.
- 2) The lower left stand-off has loctite (414) applied and tubing fitted.



The block diagram in Chapter 4, '[Circuit Descriptions](#)' shows the PCB connectors.

Separating the Front and Rear Cases *(continued)*

Spare Parts

Item	Description	Part Number
A	KIT,FRT HSG ASSY,ENG 597	141840
A	KIT,FRT HSG ASSY,ENG,597XA	141841
A	KIT,FRT HSG ASSY,ENG/AUS,597XC	141842
A	KIT,FRT HSG ASSY,ENG/AUS,597XA	141843
A	KIT,FRT HSG ASSY,DUT,598XB	141845
A	KIT,FRT HSG ASSY,ENG,598XB	141846
A	KIT,FRT HSG ASSY,FREN,598XA	141847
A	KIT,FRT HSG ASSY,FREN,598XB	141848
A	KIT,FRT HSG ASSY,GER,598XA	141849
A	KIT,FRT HSG ASSY,GER,598XB	141850
A	KIT,FRT HSG ASSY,ITAL, 598XB	141851
A	KIT,FRT HSG ASSY,SPAN,598XB	141852
A	KIT,FRT HSG ASSY, SWED, 598XB	141853
B	SEAL,HSG	130051
C	KIT,HSG,REAR,597/598XA(BOM)	138050 (non-FSO)
C	KIT,HSG REAR 597XC/8XB	139049 (non-FSO)
C	KIT,REAR,HSG,597/8/9 FSO	141743 (FSO)
D	INSERT MOLDED	133665
E	COVER,TEST CONN,59X/599	130548
F	SCREW,MACH 6-32X1/4 PNH PHH	300330
G	TBG,#4,0.214 X .020	303423
*	TIE STRAP,CBL .062-1.25 MAX	301044
*	CABLE,PRES AMP BD,599	134143
*	HARN,AIL,597/8/9	133393
*	ASSY,HARN,DSPL,80/90SER(BOM)	128140
*	ASSY,HARN,OPT,58X/3080/59X/599	130038
*	CBL,34 COND,FLAT,597/8/9	132327

* item not shown

Front Case

Cam Follower Assembly, Air-In-Line Sensor

Replacement Procedure

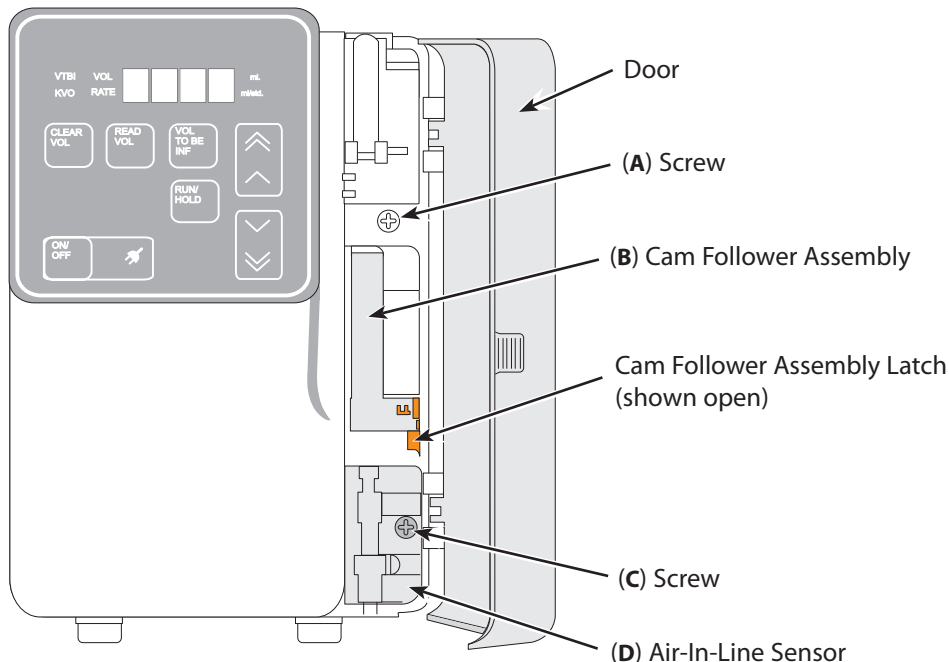
1. Open the pump door.
2. Remove the Air-In-Line Sensor assembly retaining screw (C).
3. Gently pull the Air-In-Line Sensor assembly to the right to disconnect it from the front housing.
4. Open the orange cam follower assembly latch.
5. Remove the retaining screw from the top of the Cam Follower Assembly (A).
6. With the orange cam follower assembly latch open, gently pull the Cam Follower Assembly forward and to the right, part way out of front case.
7. Disconnect the 6-pin flat pressure amplifier cable from the pressure amplifier circuit board (in the Cam Follower Assembly).
8. Remove the Cam Follower Assembly.
9. Reassemble in reverse order.
10. Run Self-Test **08** in loop mode to align the encoder disk optics. See ['Entering Self-Test Mode'](#) in Chapter 2 for instructions. If there is excessive noise, adjust the Cam Follower Assembly as far as possible towards the bottom of the pump. Tighten retaining screw to secure in place.



The mounting position of the Cam Follower Assembly is important. When refitting, first loosely fasten the retaining screw then push the Cam Follower Assembly as far as possible towards the bottom of the pump before tightening the screw to secure in place.



When replacing the Cam Follower Assembly, the Rate Calibration Number in Self Test Code 20 must be 33 otherwise change. Then the Rate Accuracy Verification and Pressure Calibration procedures must be performed. See Chapter 2, ['Routine Maintenance & Calibration'](#).



Spare Parts

Item	Description	Part Number
A	SCREW,MACH 6-32X3/8 PNH PHH	303351
B	KIT,FLWR HSG,UNIVERSAL,598	146219-000
*	GASKET,FLWR HSG,597/8/9	134191
C	SCREW,MACH,4-40X5/8,PNH,PHH,SS	304322
D	ASSY,AIL,597/8/9(BOM)	134164

* item not shown

Front Case (continued)

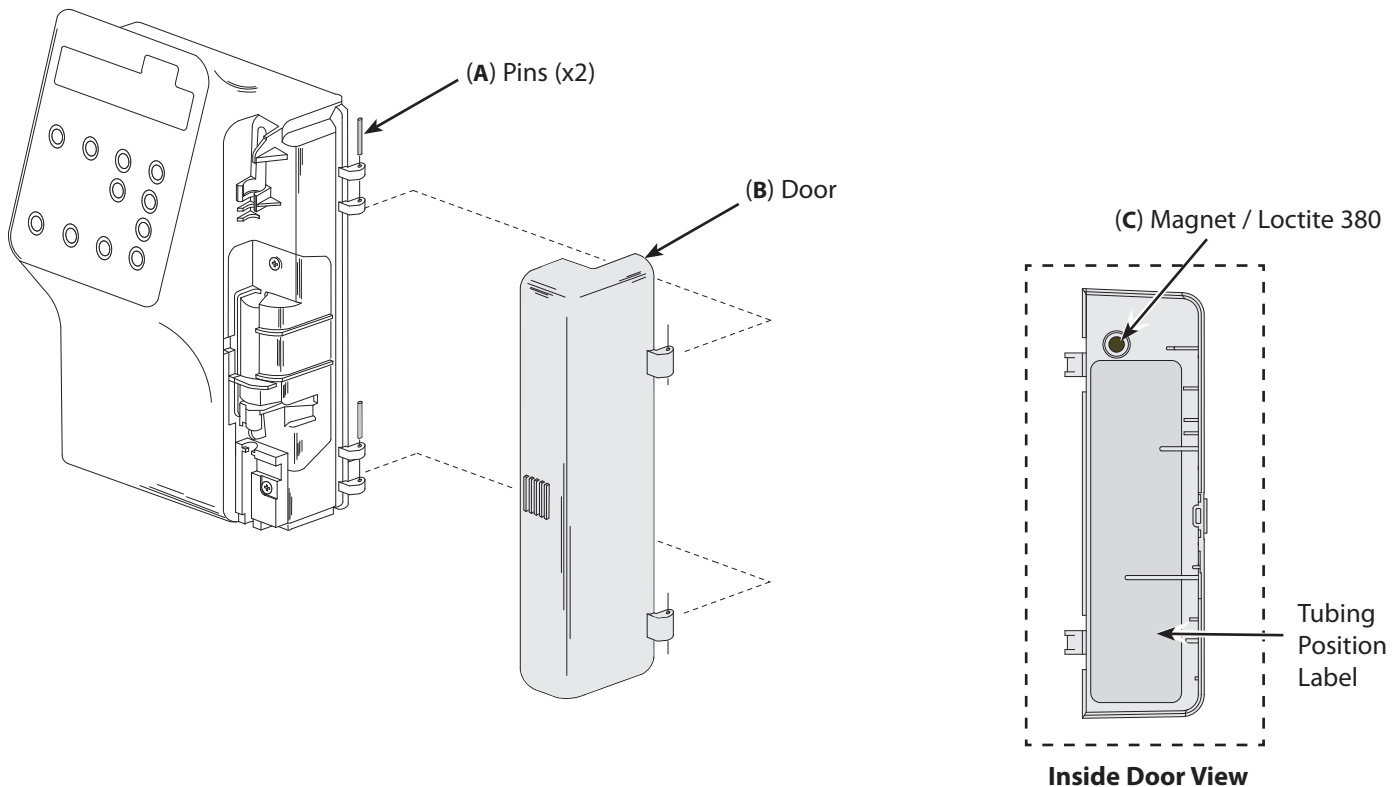
Door Assembly, Magnet

Replacement Procedure

1. Open the door and remove steel hinge pins (if still in place) to free the door.
2. Reassemble in reverse order.



When replacing the door assembly, the Door Calibration procedure must be performed. See '[Calibration Procedures](#)' in Chapter 2.



Important: Verify that the tubing position label (shown above) is the correct full length label with warning statement. See '[Labels](#)' for further details and part numbers.

Spare Parts

Item	Description	Part Number
A	PIN,DWL,,0625X.875,SS	303921
B	ASSY,DOOR,RWK,598XG-K(BOM)	144393
B	KIT,DOOR ASSY,ENG,597/8/9(BOM)	141605
B	KIT,DR ASSY,DUT,598(BOM)	141679
B	KIT,DOOR ASSY,GER,598	144677
B	KIT,DOOR ASSY,SPAN,598	141676
B	KIT,DR ASSY,ITAL,598(BOM)	141675
B	KIT,DOOR ASSY,SWED,598	141674
C	MAGNET,MAGNETIZED,CO 90C98A	302425

Front Case (continued)

Cam Housing Assembly

Replacement Procedure

1. Loosen the transformer mounting screws to allow clearance for Air-In-Line connector.
2. Remove the three screws and washers (and bracket, where fitted) which hold the Cam Housing Assembly onto the front case.
3. Cut the two tie wraps joining the wires of the motor, the transformer, and the battery.
4. Gently pull the Cam Housing Assembly back and to the right out of front case.
5. Reassemble in reverse order.



The mounting positions of the Cam Housing Assembly are important. When refitting, first loosely fasten the top, bottom then middle fixings then push the Cam Housing Assembly as far as possible towards the top of the pump. Tighten the middle screw to secure in place then tighten the top and bottom screws.



When replacing the Cam Housing Assembly, the Door Calibration procedure must be performed. See Chapter 2, '[Routine Maintenance & Calibration](#)'.

Top mounting

(A/B/C) Screw (x1) / Washer (x1) / Washer (x1)

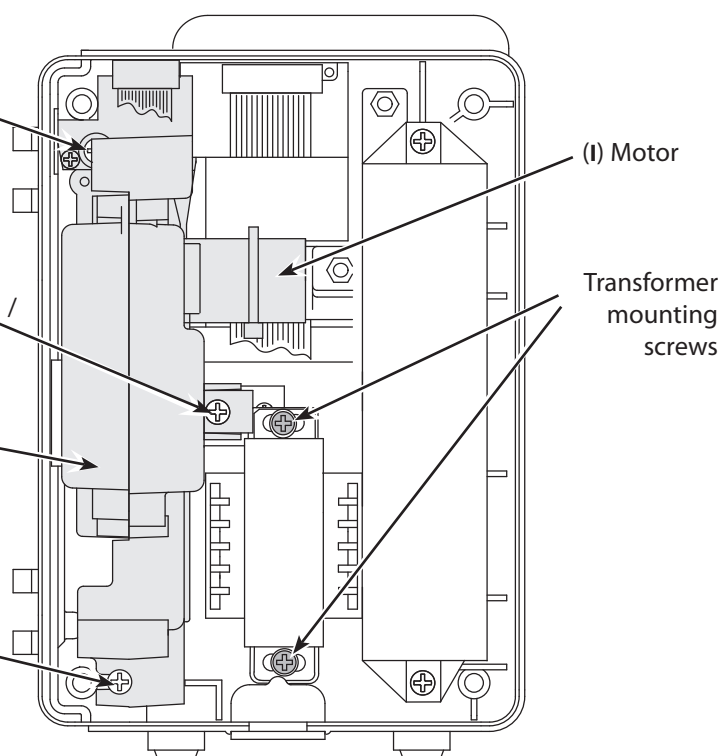
Middle mounting

(D/E/F/G) Screw (x1) / Washer (x1) / Washer (x1) / Bracket

(H) Cam Housing assembly

Bottom mounting

(A/B/C) Screw (x1) / Washer (x1) / Washer (x1)



Spare Parts

Item	Description	Part Number
A	SCREW,MACH 6-32X5/16 PNH PHH	301708
B	FLAT WASHER M3.5 DIN 433 ZINC PLATED	0000ME00652
C	WSHR,INT TTH,,146X.283X.019,PS	300389
D	SCREW,MACH 6-32X1/2 PNH PHH	301828
E	WSHR,INT TTH,,146X.283X.019,PS	300389
F	FLAT WASHER M3.5 DIN 433 ZINC PLATED	0000ME00652
G	BRACKET CAM HOUSING 59X	142197
H	CAM HOUSING ASSY , 597/8/9	142248
I	KIT,MTR DRV 591	142949

Front Case (continued)

Battery

Replacement Procedure

1. Remove the two screws securing the battery to the front case.
2. Pull the battery up and out of the front case.
3. Reassemble in reverse order.



Batteries should be given a full 24 hour charge when replaced, when pump is to be stored for an extended period of more than 3 weeks and upon receipt of a new pump.

Mounting Nut

Replacement Procedure

1. Lift the mounting nut from the cutout in the bottom of the front case.
2. Reassemble in reverse order.

Note: When reassembling the mounting nut and cap, apply loctite around the top rim of the mounting nut before sliding the cap over the mounting nut.

Transformer

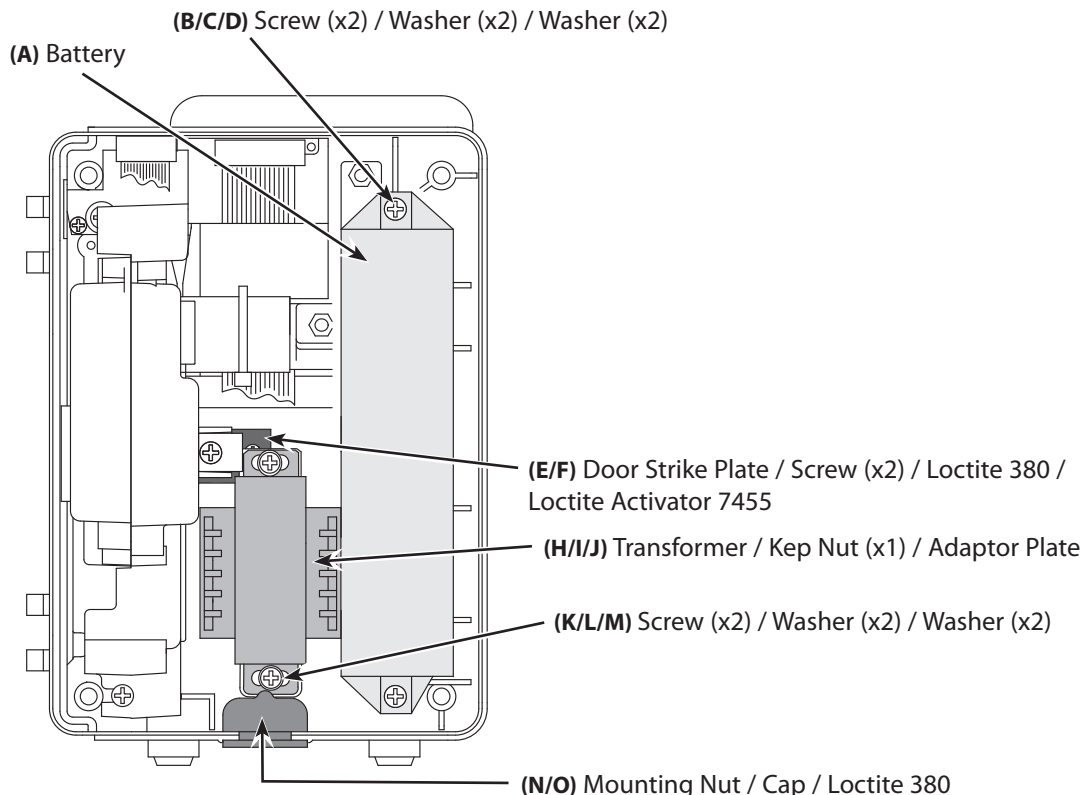
Replacement Procedure

1. Disconnect the transformer from the Power Regulator Board, the Fuse Holders and the Power Cord receptacle, desoldering wires as necessary.
2. Remove the kep nut from the side of the transformer and remove the lug with the green earth wire.
3. Remove the two screws and internal tooth washers securing the transformer to the front case.
4. Gently pull the transformer from the front case.
5. Reassemble in reverse order.

Door Strike Plate

Replacement Procedure

1. Remove the two screws securing the plate.
2. Lift out the plate.
3. Reassemble in reverse order, ensuring the front edge is aligned with the front case edge and the screws are secured with loctite.



Front Case (continued)

Battery, Transformer, Door Strike Plate, Mounting Nut (continued)

Spare Parts

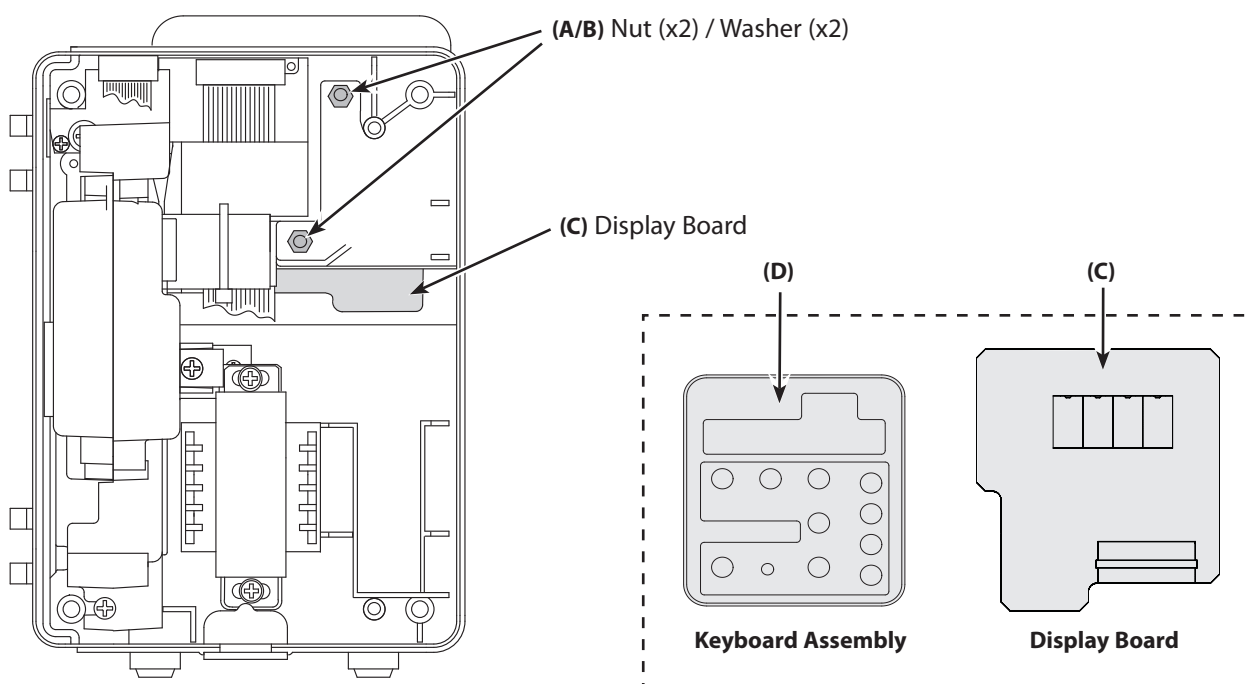
Item	Description	Part Number
A	BATT PACK,80/90 SER	129471
B	SCREW,MACH 6-32X5/16 PNH PHH	301708
C	FLAT WASHER M3.5 DIN 433 ZINC PLATED	0000ME00652
D	WSHR,INT TTH,.146X.283X.019,PS	300389
E	PL,STRIKE,DOOR,2OP,59X/599BOM	132233
F	SCREW,MACH 4-40X3/16 PNH PHH	301711
H	ASSY,XFMR,220V,80/90 SER	133614
H	KIT,XFMR,581,591/7/8	143855
I	NUT,KEP 6-32 S PL	300036
J	PL,ADPT,XFMR,220V	133091
K	SCREW,MACH 6-32X3/8 PNH PHH	300034
L	WSHR,INT TTH,.146X.283X.019,PS	300389
M	WSHR,FL,.4BA T2 ST/STA2	300510
N	NUT,MTG	130048
O	CAP,VINYL 0.875-5	303246

Front Case (continued)

Display Board, Keyboard Assembly

Replacement Procedure

1. Disconnect the ribbon connector (extending from Display Board) from the Logic Board.
2. Remove the two nuts and washers which secure the Display and Keyboard Assembly to the front case.
3. Gently push the Display Board outward from inside front case by pushing on the ends of the two screws.
4. Disconnect the Keyboard Assembly (if necessary) by lifting the Keyboard Assembly off until its two rear screws clear the Display Board.
5. Disconnect the Keyboard Assembly flex cable from the Display Board.
6. Reassemble in reverse order, taking note of the following points:
 - Ensure the display seal is installed all along the inner recessed edge that goes around the sides of the Keyboard Assembly as close to the outer elevated lip as possible.
 - Ensure the Keyboard Assembly flex cable does not get pinched.
 - Ensure the gasket is intact, and not pinched or rolled.



Spare Parts

Item	Description	Part Number
A	NUT,KEP 4-40 S PL	300045
B	LAT WASHER M3.5 DIN 433 ZINC PLATED	0000ME00652
C	ASSY,DSPL BD,58X/90 SER(BOM)	140117-1
D	KIT,KYBD/OVLY,ENG,599/597(BOM)	133295
D	KIT,KYBD/OVLY,FREN,598(BOM)	138989
D	KIT,KYBD/OVLY,GER,598(BOM)	135961
D	KIT,KYBD/OVLY,DUT,598	139052
D	KIT,KYBD/OVLY,ENG,598	139050
D	KIT,KYBD/OVLY,ITAL,598	139054
D	KIT,KYBD/OVLY,SPAN,598	139053
D	KIT,KYBD/OVLY,SWED,598	139051
*	FOAM,0.062TX0.125W GREY	302932

* item not shown

Rear Case

Logic Board, Power Regulator Board

Replacement Procedure

1. Disconnect all cables connected to the Power Regulator Board except the flat ribbon cable connecting to the Logic Board.
2. Disconnect the 26-pin cable connecting the Display Board to the Logic Board (at J1).
3. Remove the three screws and washers securing the boards to the rear case.
4. Remove both the Power Regulator and the Logic Board from the rear case. Remove ESD shield if required.
5. Disconnect the flat ribbon cable connecting the Logic Board and Power Regulator Board.
6. Reassemble in reverse order.

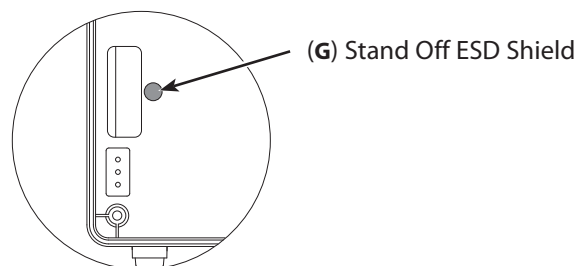
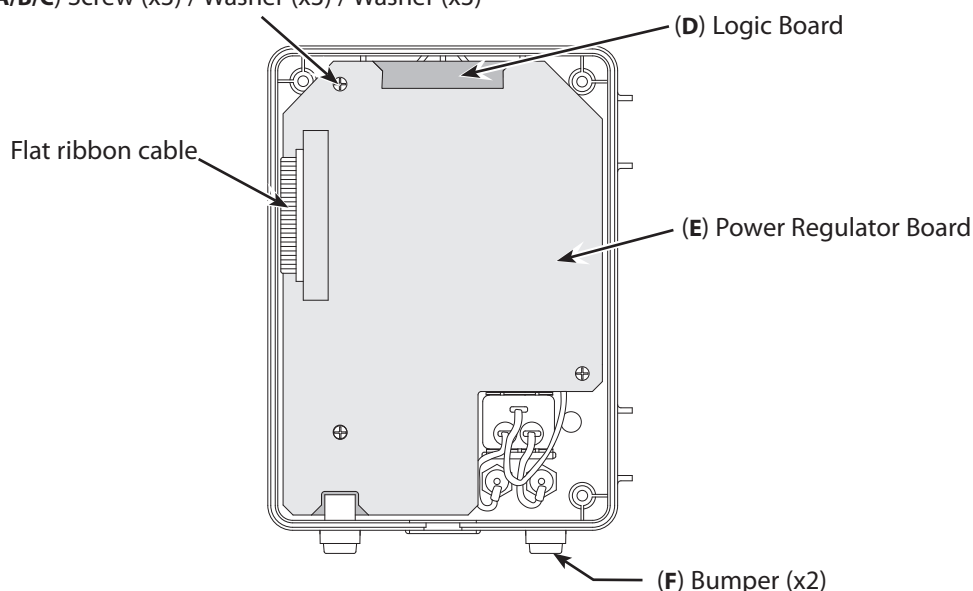
Refitting notes:

- 1) Check that the inside rear case is fitted with a stand off ESD shield (see Item G) and fit if necessary.
- 2) Ensure the PVC foam gasket is installed over the flow sensor pins onto the back of the Logic Board. If the gasket is worn or deteriorated, install a new gasket onto the flow sensor pins before installing the boards into the rear case.
- 3) Peel off the speaker hole protective cover before connecting the boards with the flat ribbon cable.
- 4) The flat ribbon cable should be routed to the outside of both boards at the edge of the housing and should not be between the boards.
- 5) Verify the alignment of the speaker hole with the bottom hole in the rear housing.



Important: When replacing the Logic Board (139046-100) on a non-FSO pump ensure that self-test 36 is set to FS.OP (Flow Sensor Optional).

(A/B/C) Screw (x3) / Washer (x3) / Washer (x3)



Rear Case (continued)

Logic Board, Power Regulator Board (continued)

Spare Parts

Item	Description	Part Number
A	SCREW,MACH 6-32X7/8 PNH PHHD	300361
B	FLAT WASHER M3.5 DIN 433 ZINC PLATED	0000ME00652
C	WSHR,INT TTH,.146X.283X.019,PS	300389
D**	IT, LGC BD ASSY, NON FSO, 59X	139046-100 (non-FSO)
D	ASSY,LGC BD,CAL,FSO/NRSCL,597/8/9	144702
E	ASSY,PWR REG BD,CAL, 597/8/9	142085
F	BUMPER,RBR,.50" X .14	303724
G	STAND OFF SHIELD ESD 59X	1000ME00514
*	GASKET,PVC FOAM,597/8/9 FSO	141096
*	ESD SHIELD 59X	1000ME00452
*	SERV,ASSY,MEM,1.10,597/8/9 FSO	143053
*	KIT,REV 10.05,ENG,599XC/8/7	136814 (non-FSO)
*	IC,WATCH DOG,GATE ARRAY	128048
*	KIT,XDCR,AUD,590/1,2,597/8/9	140147
*	XSTR,VN0610,MOSFET,N-CHAN	302422
*	IC,RAM,2KX8,CMOS,24 DIP	302627
*	IC,74HC373,H SP LTCH 20 DIP	302695
*	XTAL,32.768KHZ	303141
*	IC,80C31,MICROCONTROLLER,40DIP	303287 (non-FSO)
*	FUSE,1.5A,250V,NORM-BLO	303910
*	XSTR,3638A,PNP,AMP/SW,TO-92	300702
*	XSTR,3569,NPN,AMP/SW,TO-92	301551
*	XSTR,6109,PNP,PWR,TO-220AB	301553

* item not shown

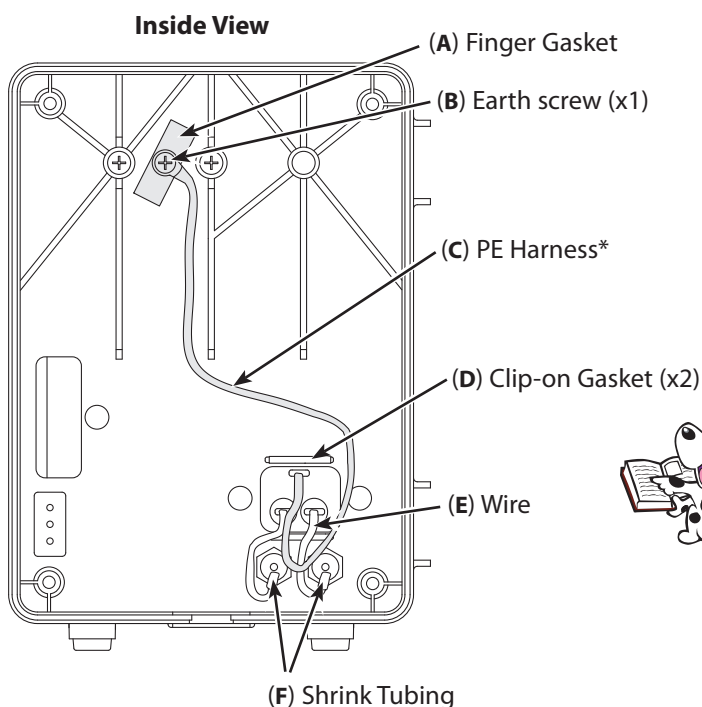
** see Important note on previous page

Rear Case (continued)

Fuse Holders

Replacement Procedure

1. Desolder the black transformer wire from the top tab of the left fuse holder and the brown wire from the top tab on the right fuse holder.
2. Loosen and remove the hex nut connecting the fuse holder to the back of the rear case.
3. Gently remove fuse holder from inside rear case.
4. Reassemble in reverse order.



Items A, B C and D are not on XAX model pumps. See also 'Views of the IVAC® 597/598 Volumetric Pump' in Chapter 1.

Mains Inlet Assembly

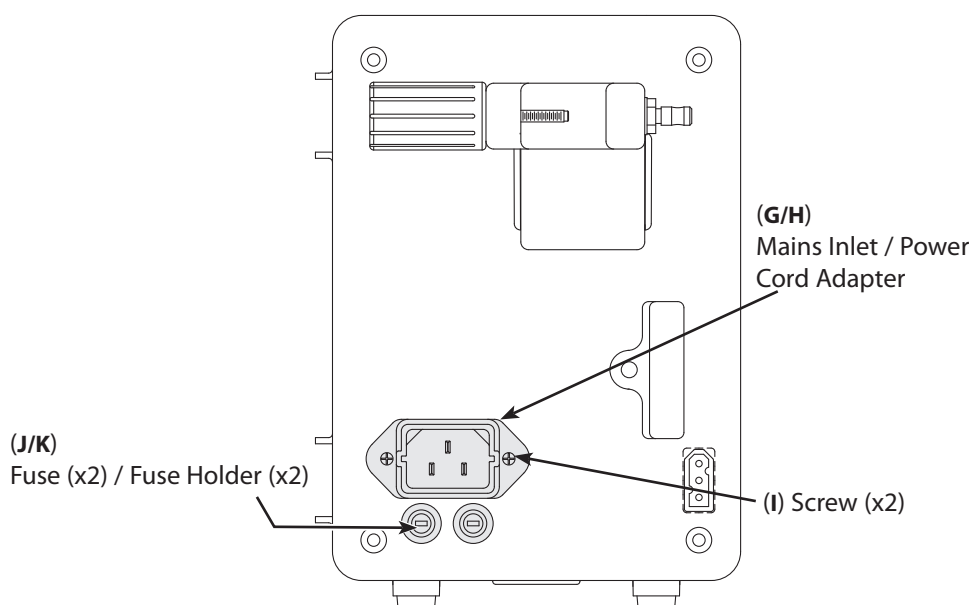
Replacement Procedure

1. Detach the two connectors inside the rear case, and unsolder the green/yellow ground wire connection at the mains inlet assembly.
2. Remove the one earth screw from inside the rear case.
3. Remove the two screws securing the power cord adapter to the back of rear case and remove the power cord adapter and mains inlet assembly.
4. Reassemble in reverse order.

Refitting notes:

- 1) The finger gasket (A) must be orientated diagonally, upper right to lower left.
- 2) Fingers of the clip-on gasket (D) must contact the line filter.
- 3) Fit the mains inlet into the rear case with the single pin uppermost. Note: The ground symbol label is located on the uppermost side of mains assembly.

Back View



Rear Case (continued)

Fuse Holders, Mains Inlet Assembly (continued)

Spare Parts

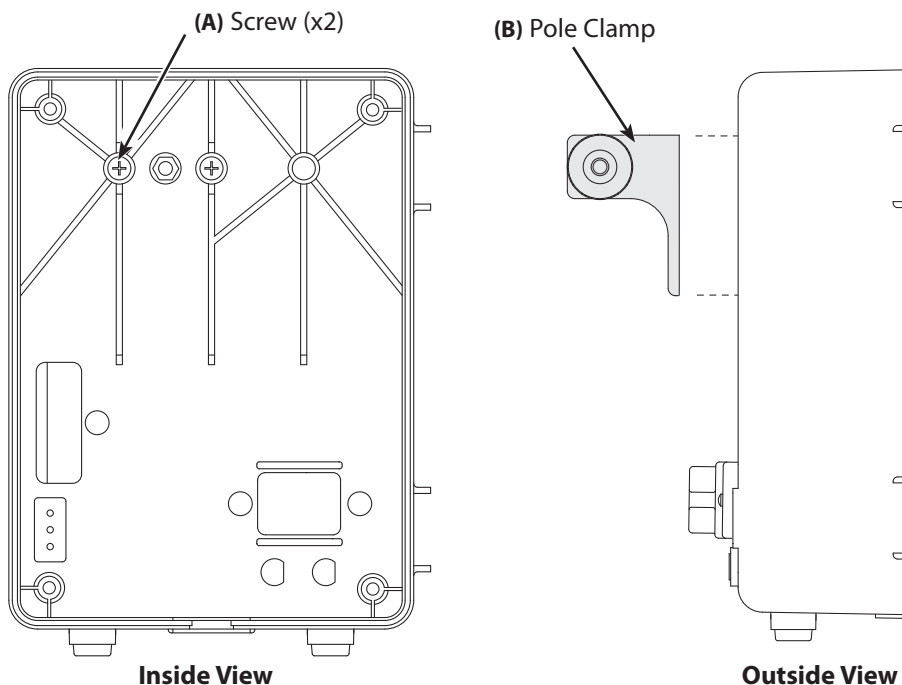
Item	Description	Part Number
A	GASKET,FINGER,COPPER,TIN PLATE	304766
B	SCREW,MACH,6-32X3/16,PNH,PHH	304209
C	HARNESS,P.E.,597XC/8XB	137737
C	ASSY,HARN,GND,80/90SER (BOM)	130210
D	GASKET,CLIP-ON,T-LANCE,COPPER	304817
E	WIRE,ELEC STRD,18 AWG,BLK	301073
F	TBG,SHRK,CLEAR,.184,POLYOLEFIN	300609
G	CONN,PWR/CD REC 3/P 6A 250V (597/598XA)	303250
G	ASSY,LINE EMI FLTR,597XC/8XB	139048
H	ADPT,IEC PWR/CD CONN	303249
I	SCREW,TPG #4-20X.500 PNH PHH	303501
J	FUSE,63MA 250V TIME LAG	303489
K	FUSE HLDR,PNL MNT,FEF 031.1085	303467
*	ASSY,LINE EMI FLTR,597XC/8XB	139048
*	KIT,ADAPT	132520
*	LBL,GND SYM	123273
*	TBG,SHRK,BLACK,.250,POLYOLEFIN	300610

* item not shown

Pole Clamp

Replacement Procedure

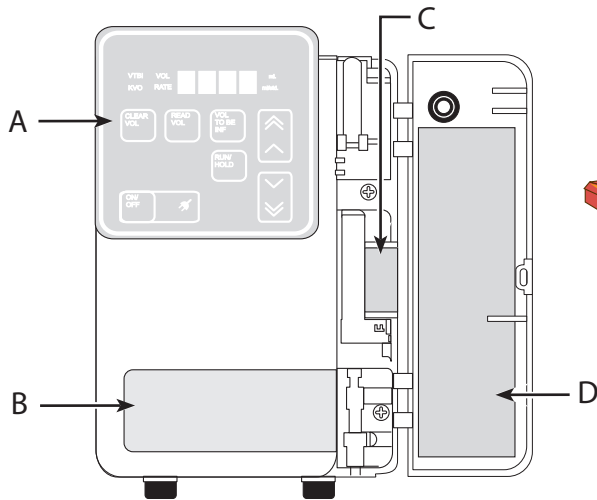
1. Remove the two screws from inside the rear case.
2. Reassemble in reverse order.



Spare Parts

Item	Description	Part Number
A	SCREW,MACH 6-32X1/2 PNH PHH	301828
B	KIT,POLE CLAMP,597/8XA,599	138051
B	ASSY,CLAMP,POLE,597XC/8XB(BOM)	137522

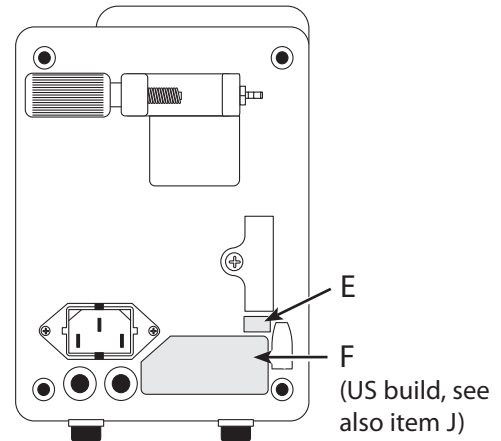
Labels



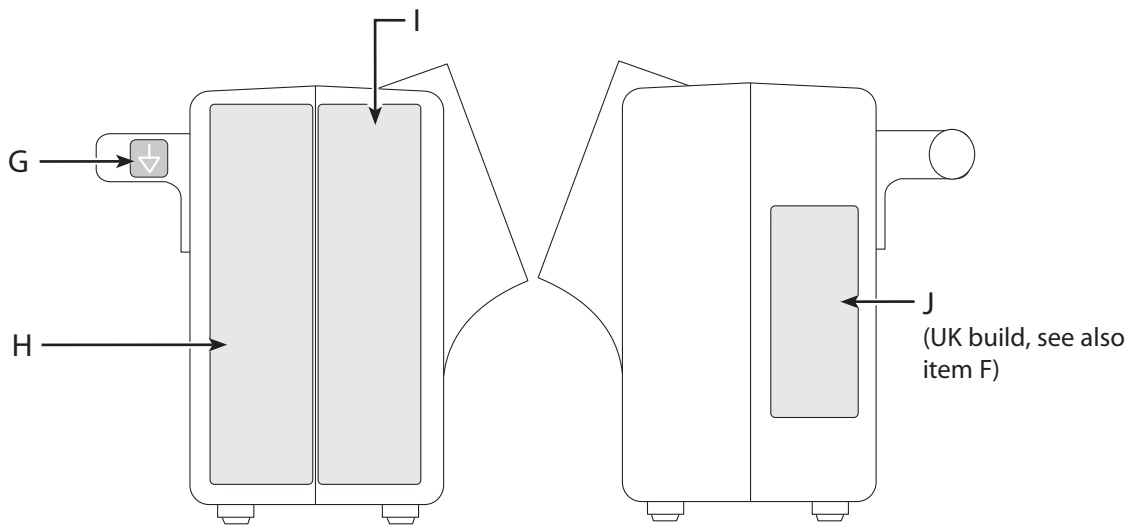
Front View



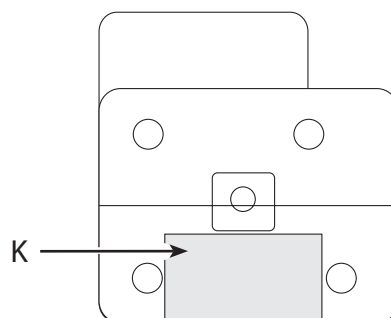
Important: Verify that the tubing position label (D) is the correct full length label with warning statement. Check part number and replace existing label if necessary.



Rear View



Side Views



Underside View

Labels (continued)

Spare Parts

Item	Description	Part Number
A	OVLY,SW PANEL,ITAL,598(BOM)	138961
A	OVLY,SW PANEL,SWED,598(BOM)	137603
A	OVLY,SW PANEL,SPAN,599FSO/598	137605
A	OVLY,SW PANEL,GER,598(BOM)	136013
A	OVLY,SW PANEL,ENG,599FSO/598	138675
A	OVLY,SW PANEL,DUT,598(BOM)	138593
A	OVLY,SW PANEL,FREN,598(BOM)	138975
A	OVLY,SW PANEL,ENG,597/9(BOM)	132335
B	LBL VPVP ENG 597 (BOM)	135734
B	LBL,SPACE*SAVER,AUST,597(BOM)	137281
B	LBL,VPVP,DUT,598(BOM)	137619
B	LBL VPVP ENG 598 (BOM)	138668
B	LBL VPVP FREN 598 (BOM)	135773
B	LBL,VPVP,GER,598(BOM)	135737
B	LBL VPVP ITAL 598 (BOM)	137589
B	LBL,VPVP,SPAN,598(BOM)	137623
B	LBL VPVP SWED 598 (BOM)	137621
C	LBL,SET LOADING, ENG,59X	131866
C	LBL,SET LOAD,GER,591/598	131738
C	LBL,SET LOAD,DUT,591/598	131739-000
C	LBL SET LOAD ITAL 591/598	131740
C	LBL,SET LOAD,SPAN,591/598	131737
C	LBL,SET LOAD,SWED,591/598	131735
C	LBL,SET LOAD,FREN,590/1/8	144178
D	LBL,TBG POSN,ENG,597/8/9	141565
D	LBL,TBG POSN,FREN,598	143671
D	LBL,TBG POSN,DUT,598	141686-000
D	LBL,TBG POSN,ITAL,598	141682
D	LBL,TBG POSN,GER,598	141684
D	LBL,TBG POSN,SPAN,598	141683
D	LBL,TBG POSN,SWED,598	141681
E	LBL,FLOW SNSR,DUT,281/581/591	126118
E	LBL,FLOW SNSR,GER,281/581/591	126105
E	LBL,FLOW SNSR,SPAN,28X/58X/591	126124
E	LBL,FLOW SNSR,ITAL,581/591	126152
E	LBL,FLOW SNSR,FREN,80/90SER	126106
E	LBL,FLOW SNSR,SWED,281/581/591	126119
E	LBL,FLOW SNSR,ENG,80/90SER	128100
F	LBL,NAME/RATING,ENG,597	136006
F	LBL,NAME RATING,598	136007
G	LBL,EQ POT CONN	133318

Labels (continued)

Spare Parts

Item	Description	Part Number
H	LBL,START-UP,ENG,597(BOM)	135708
H	LBL,START-UP,DUT,598(BOM)	137607
H	LBL START UP ENG 598 (BOM)	138671
H	LBL START UP FREN 598(BOM)	135710
H	LBL,START-UP,GER,598(BOM)	135712
H	LBL START UP ITAL 598 (BOM)	137588
H	LBL,START-UP,SPAN,598(BOM)	137611
H	LBL START UP SPAN 598(BOM)	137609
H	LBL,START-UP,DUT,598 FSO	141421
H	LBL,START-UP,ENG,597XD	141333
H	LBL,START-UP,ENG,598XC	141334
H	LBL,START-UP,ITAL,598 FSO	141400
H	LBL,START-UP,SWED,598 FSO	141404
H	LBL,START-UP,SPAN,598 FSO	141408
H	LBL,START-UP,FREN,598 FSO	141412
H	LBL,START-UP,GER,598 FSO	141416
H	IVAC 597 START UP LABEL DUTCH	1000LB01482
I	LBL,ALARM MESS,DUT,598(BOM)	137613
I	LBL,ALARM MESS,ENG,598(BOM)	140166
I	LBL ALARM MESS FREN 598 (BOM)	135913
I	LBL,ALARM MESS,GER,598(BOM)	138026
I	LBL ALARM MESS ITAL 598 (BOM)	137587
I	LBL,ALARM MESS,SPAN,598(BOM)	137617
I	LBL ALARM MESS SWED 598(BOM)	137615
I	LBL,MESS,ENG,598XC	141336
I	LBL,ALARM MESS,ENG,597 FSO	141335
I	LBL,ALARM,MESS,ITAL,598,FSO	141398
I	LBL,ALARM MESS,SWED,598 FSO	141402
I	LBL,ALARM MESS,SPAN,598 FSO	141406
I	LBL,ALARM MESS,FREN,598 FSO	141410
I	LBL,ALARM MESS,DUT,598 FSO	141419
I	LBL,ALARM MESS,GER,598 FSO	141414
I	IVAC 597 ALARM MESSAGE LABEL DUTCH	1000LB01483
J	LABEL NAME RATING 59X	1000LB01448
K	LBL,PATENT NTC,597/598/599	137816
*	LBL,GND SYM	123273
*	LBL,BATT,TYPE	137779
*	LBL CE MARK INST MDD	136933

* item not shown

Specifications

In this chapter

Infusion	55
Electrical	55
Physical	55
Environmental	55
Recycling	55
Electromagnetic Compatibility	56

Specifications

Infusion

Rate range	1 to 999 ml/h in 1 ml increments
Volume infused range	Total: 0 to 9999 ml in 1 ml increments Secondary: 1 to 9999 ml in 1 ml increments (Model 597 only)
Volume To Be Infused range	Primary: 1 to 9999 ml in 1 ml increments Secondary: 1 to 999 ml in 1 ml increments (Model 597 only)
KVO rate	5 ml/h or current set rate if less than 5 ml/h in primary operation
Air-in-line accuracy	100 µl ±50 µl
Maximum bolus volume	At 1 ml/h: 0.5 ml At 100 ml/h: 0.5 ml
Maximum time to alarm	At 1 ml/h; 35 minutes At 100 ml/h; 0.31 minutes
Occlusion pressure	Maximum: 11 psi (569 mmHg); Nominal: 6 to 8 psi
System Accuracy	±5% with a 1.96 standard deviation under specified conditions. Note: Accuracy specified under the following conditions: Head height: 30"/76.2cm, Test solution: distilled water, Environmental: ambient temperature, Back pressure: 20 gauge needle, IV set: Model 59073
Critical volume	25 ml at 999 ml/h is maximum incremental volume which can occur in case of single point failure
IV administration set	IVAC® "59" Series IV Infusion sets only

Electrical

Battery type	Lead acid, sealed, rechargeable 6V/3.4Ah. Automatically charges when the pump is connected to AC power
Battery life	6 hours @ 125 ml/h with a fully charged, new battery
Battery recharge time	Approximately 24 hours from discharge to 100% charge
Power requirements	220 to 240V AC; 50/60 Hz; 0.07A; 3-wire grounded system
External fuses	2 x T63 mA 250V
Memory retention	At 25°C, the electronic memory of the pump will be retained for at least 6 months when not powered up
Ground current leakage	Maximum 100µA rms (ungrounded) at 220V rms
Protection against electrical shock hazards	Class I Type CF

Physical

Weight	Approximately 2.7 kg		
Case material	Impact resistant ABS plastic		
Dimensions	W	H	D
	13.3 cm	19.3 cm	18.4 cm

Environmental

IPX rating	IPX1		
Operating limits	Temperature	Relative humidity	Atmospheric pressure
	+10°C to +40°C	30% to 75% non-condensing	700 - 1060 hPa
Transport/storage limits	-40°C to +70°C	0% to 100%	500 - 1060 hPa

Recycling

Disposal of device components

Caution: Follow local governing ordinances and recycling instructions regarding disposal or recycling of device components, including batteries.

Electromagnetic Compatibility

Warning:

- The use of any accessory, transducer, or cable with the IVAC® Volumetric Pump (Models 597 & 598) other than those specified may result in increased emissions or decreased immunity of the pump.
- The IVAC® Volumetric Pump (Models 597 & 598) should not be used adjacent to or stacked with other equipment, however if adjacent or stacked use is necessary, the IVAC® Volumetric Pump (Models 597 & 598) should be observed to verify normal operation in the configuration in which it will be used.

Caution:

- The IVAC® Volumetric Pump (Models 597 & 598) is a CISPR 11 Group 1 Class A Medical Equipment System and intended for use by healthcare professionals only.
- Medical Electrical Equipment needs special precautions regarding EMC and needs to be installed, put into service and used according to the EMC information provided in the accompanying documents.
- Portable and Mobile RF communications can affect Medical Electrical Equipment.
- Operating the pump near equipment which radiates high energy radio frequencies (electro surgical or cauterizing equipment, portable radios, cellular telephones, etc.) may cause false alarm conditions. If this happens, reposition the pump away from the source of interference or turn off the pump and manually regulate the flow.

Guidance and Manufacturer's Declaration – Electromagnetic Emissions

The IVAC® Volumetric Pump (Models 597 & 598) is intended for use in the electromagnetic environment specified below. The customer or the user of the IVAC® Volumetric Pump (Models 597 & 598) should assure that it is used in such an environment.

Emissions Test	Compliance	Electromagnetic Environment – Guidance
CISPR 11 RF Emissions	Group 1	The pump uses RF energy only for its internal function in the normal product offering. Therefore, its RF emissions are very low and are not likely to cause any interface in nearby electronic equipment.
CISPR 11 RF Emissions	Class A	The pump is suitable for use in all establishments, other than domestic, and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
EN 61000-3-2 Harmonic Emissions	Class A	
EN 61000-3-3 Voltage Fluctuations, Flicker Emissions	Complies	

Electromagnetic Compatibility (continued)

Guidance and Manufacturer's Declaration - Electromagnetic Immunity

The IVAC® Volumetric Pump (Models 597 & 598) is intended for use in the electromagnetic environment specified below. The customer or the user of IVAC® Volumetric Pump (Models 597 & 598) should assure that it is used in such an environment.

Immunity Test	EN 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment – Guidance
EN 61000-4-2 Electro-Static Discharge (ESD)	±6 kV contact ±8 kV air	±8 kV contact (Note 2) ±15 kV air (Note 2)	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
EN 61000-4-4 Electrical Fast Transient, Burst (EFT) (Note 3)	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines N/A (Note 4)	Mains power quality should be that of a typical commercial or hospital environment.
EN 61000-4-5 Power Line Surge (Note 3)	±1 kV Line(s) to Line(s) ±2 kV Line(s) to Earth	±1 kV Line(s) to Line(s) ±2 kV Line(s) to Earth	Mains power quality should be that of a typical commercial or hospital environment.
EN 61000-4-8 Power Frequency Magnetic Field (50/60 Hz)	3 A/m	400 A/m 50 Hz (Note 2)	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
EN 61000-4-11 Voltage Dips, Short Interruptions, and Voltage Variations (Note 3)	<5 % <i>UT</i> (Note 1) (>95 % dip in <i>UT</i>) for 0.5 cycle	<5 % <i>UT</i> (>95 % dip in <i>UT</i>) for 0.5 cycle	Mains power quality should be that of a typical commercial or hospital environment. If the user of the pump requires continued operation during power mains interruptions, it is recommended that the pump be powered from an uninterruptible power supply or a battery. The pump does employ an internal short duration battery.
	40 % <i>UT</i> (60 % dip in <i>UT</i>) for 5 cycles	40 % <i>UT</i> (60 % dip in <i>UT</i>) for 5 cycles	
	70 % <i>UT</i> (30 % dip in <i>UT</i>) for 25 cycles	70 % <i>UT</i> (30 % dip in <i>UT</i>) for 25 cycles	
	<5 % <i>UT</i> (>95 % dip in <i>UT</i>) for 5 sec	<5 % <i>UT</i> (>95 % dip in <i>UT</i>) for 5 sec	

Note 1—*U_r* is the AC mains voltage prior to application of the test level.

Note 2—Compliance levels raised by EN 60601-2-24.

Note 3—Performed at the Minimum and Maximum Rated Input Voltage.

Note 4—CareFusion recommends using signal cables of less than 3 meters in length and this requirement is applicable only if signal cables are 3 meters or more in length. (EN 60601-1-2:2002, Clause 36.202.4)

Electromagnetic Compatibility (continued)

Guidance and Manufacturer's Declaration—Electromagnetic Immunity LIFE SUPPORT Equipment

The IVAC® Volumetric Pump (Models 597 & 598) is intended for use in the electromagnetic environment specified below. The customer or the user of the IVAC® Volumetric Pump (Models 597 & 598) should ensure that it is used in such an environment.

Immunity Test	EN 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment – Guidance
EN 61000-4-6 Conducted RF	3 V rms 150 kHz to 80 MHz	10 V rms (Note 3)	Portable and mobile RF communications equipment should be used no closer to any part of the pump, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended Separation Distance $d = \left[\frac{3.5}{V_1} \right] \sqrt{P}$ $d = \left[\frac{12}{V_2} \right] \sqrt{P} \quad 80 \text{ MHz to } 800 \text{ MHz}$ $d = \left[\frac{12}{E_1} \right] \sqrt{P} \quad 80 \text{ MHz to } 2.5 \text{ GHz}$ $d = \left[\frac{23}{E_1} \right] \sqrt{P} \quad 800 \text{ MHz to } 2.5 \text{ GHz}$ where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).^a Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,^b should be less than the compliance level in each frequency range.^c Interference may occur in the vicinity of equipment marked with the following symbol: 
EN 61000-4-3 Radiated RF	3 V/m 80 MHz to 2.5 GHz	10 V/m (Note 3)	

Note 1—At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2—These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Note 3—Compliance levels raised by EN 60601-2-24.

^a The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.

^b Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the pump is used exceeds the applicable RF compliance level above, the pump should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the pump.

^c Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.

Electromagnetic Compatibility (continued)

Recommended Separation Distances for LIFE SUPPORT Equipment between portable and mobile RF communications equipment and the IVAC® Volumetric Pump (Models 597 & 598)

The IVAC® Volumetric Pump (Models 597 & 598) is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled.

The user of the IVAC® Volumetric Pump (Models 597 & 598) can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the IVAC® Volumetric Pump (Models 597 & 598) as recommended below, according to the maximum output power of the communications equipment.

Rated Maximum Output Power of Transmitter W	Separation Distance According to Frequency of Transmitter m			
	150 kHz to 80 MHz Outside ISM bands 3.5 $d = \left[\frac{3.5}{V1} \right] \sqrt{P}$	150 kHz to 80 MHz In ISM bands 12 $d = \left[\frac{12}{V2} \right] \sqrt{P}$	80 MHz to 800 MHz 12 $d = \left[\frac{12}{E1} \right] \sqrt{P}$	800 MHz to 2.5 GHz 23 $d = \left[\frac{23}{E1} \right] \sqrt{P}$
0.01	0.03	0.12	0.12	0.23
0.1	0.11	0.38	0.38	0.73
1	0.35	1.20	1.20	2.30
10	1.11	3.80	3.80	7.28
100	3.50	12.00	12.00	23.00

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1—At 80 MHz and 800 MHz, the separation distance for the higher frequency range apply.

Note 2—The ISM (Industrial, Scientific, and Medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.

Note 3—An additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas.

Note 4—These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Spare Parts Listing

In this chapter

Front Case Parts Listing	61
Rear Case Parts Listing	62
Electrical Parts Listing	63
Software	63
Labels	64
Test Equipment & Accessories	65

Front Case Parts Listing

Part Number	Description
141840	KIT,FRT HSG ASSY,ENG 597
141841	KIT,FRT HSG ASSY,ENG,597XA
141842	KIT,FRT HSG ASSY,ENG/AUS,597XC
141843	KIT,FRT HSG ASSY,ENG/AUS,597XA
141845	KIT,FRT HSG ASSY,DUT,598XB
141846	KIT,FRT HSG ASSY,ENG,598XB
141847	KIT,FRT HSG ASSY,FREN,598XA
141848	KIT,FRT HSG ASSY,FREN,598XB
141849	KIT,FRT HSG ASSY,GER,598XA
141850	KIT,FRT HSG ASSY,GER,598XB
141851	KIT,FRT HSG ASSY,ITAL, 598XB
141852	KIT,FRT HSG ASSY,SPAN,598XB
141853	KIT,FRT HSG ASSY, SWED, 598XB
146219-000	KIT,FLWR HSG,UNIVERSAL,598
134191	GASKET,FLWR HSG,597/8/9
134164	ASSY,AIL,597/8/9(BOM)
303351	SCREW,MACH 6-32X3/8 PNH PHH
304322	SCREW,MACH,4-40X5/8,PNH,PHH,SS
141605	KIT,DOOR ASSY,ENG,597/8/9(BOM)
141674	KIT,DOOR ASSY,SWED,598
141675	KIT,DR ASSY,ITAL,598(BOM)
141676	KIT,DOOR ASSY,SPAN,598
144677	KIT,DOOR ASSY,GER,598
141679	KIT,DR ASSY,DUT,598(BOM)
144393	ASSY,DOOR,RWK,598XG-K(BOM)
303921	PIN,DWL,.0625X.875,SS
302425	MAGNET,MAGNETIZED,CO 90C98A
142248	CAM HOUSING ASSY , 597/8/9
142197	BRACKET CAM HOUSING 59X
301708	SCREW,MACH 6-32X5/16 PNH PHH
301828	SCREW,MACH 6-32X1/2 PNH PHH
300389	WSHR,INT TTH, .146X.283X.019,PS
0000ME00652	FLAT WASHER M3.5 DIN 433 ZINC PLATED
142949	KIT,MTR DRV 591
132233	PL,STRIKE,DOOR,2OP,59X/599BOM
301711	SCREW,MACH 4-40X3/16 PNH PHH
300036	NUT,KEP 6-32 S PL
300034	SCREW,MACH 6-32X3/8 PNH PHH
300510	WSHR,FL,.4BA T2 ST/STA2
130048	NUT,MTG
303246	CAP,VINYL 0.875-5
133295	KIT,KYBD/OVLY,ENG,599/597(BOM)
135961	KIT,KYBD/OVLY,GER,598(BOM)
138989	KIT,KYBD/OVLY,FREN,598(BOM)
139050	KIT,KYBD/OVLY,ENG,598

Front Case Parts Listing *(continued)*

Part Number	Description
139051	KIT,KYBD/OVLY,SWED,598
139052	KIT,KYBD/OVLY,DUT,598
139053	KIT,KYBD/OVLY,SPAN,598
139054	KIT,KYBD/OVLY,ITAL,598
302932	FOAM,0.062TX0.125W GREY
300045	NUT,KEP 4-40 S PL
303423	TBG,#4,0.214 X .020
301044	TIE STRAP,CBL .062-1.25 MAX

Rear Case Parts Listing

Part Number	Description
138050	KIT,HSG,REAR,597/598XA(BOM)
139049	KIT,HSG REAR 597XC/8XB
141743	KIT,REAR,HSG,597/8/9 FSO
130051	SEAL,HSG
130548	COVER,TEST CONN,59X/599
133665	INSERT MOLDED
300330	SCREW,MACH 6-32X1/4 PNH PHH
300361	SCREW,MACH 6-32X7/8 PNH PHHD
0000ME00652	FLAT WASHER M3.5 DIN 433 ZINC PLATED
300389	WSHR,INT TTH, .146X.283X.019,PS
303724	BUMPER,RBR,.50" X .14
141096	GASKET,PVC FOAM,597/8/9 FSO
304766	GASKET,FINGER,COPPER,TIN PLATE
304817	GASKET,CLIP-ON,T-LANCE,COPPER
304209	SCREW,MACH,6-32X3/16,PNH,PHH
303501	SCREW,TPG #4-20X.500 PNH PHH
300609	TBG,SHRK,CLEAR,.184,POLYOLEFIN
139048	ASSY,LINE EMI FLTR,597XC/8XB
132520	KIT,ADAPT
300610	TBG,SHRK,BLACK,.250,POLYOLEFIN
138051	KIT,POLE CLAMP,597/8XA,599
137522	ASSY,CLAMP,POLE,597XC/8XB(BOM)
301828	SCREW,MACH 6-32X1/2 PNH PHH

Electrical Parts Listing

Part Number	Description
128140	ASSY,HARN,DSPL,80/90SER(BOM)
130038	ASSY,HARN,OPT,58X/3080/59X/599
133393	HARN,AIL,597/8/9
132327	CBL,34 COND,FLAT,597/8/9
134143	CABLE,PRES AMP BD,599
136062-1	ASSY,SNSR BD,OPT,59X/597/8/9
129471	BATT PACK,80/90 SER
143855	KIT,XFMR,581,591/7/8
133614	ASSY,XFMR,220V,80/90 SER
133091	PL,ADPT,XFMR,220V
140117-1	ASSY,DSPL BD,58X/90 SER(BOM)
139046-100	IT, LGC BD ASSY, NON FSO, 59X
144702	ASSY,LGC BD,CAL,FSO/NRSCL,597/8/9
142085	ASSY,PWR REG BD,CAL, 597/8/9
137737	HARNESS,P.E.,597XC/8XB
130210	ASSY,HARN,GND,80/90SER (BOM)
1000ME00452	ESD SHIELD 59X
140147	KIT,XDCR,AUD,590/1,2,597/8/9
300702	XSTR,3638A,PNP,AMP/SW,TO-92
301551	XSTR,3569,NPN,AMP/SW,TO-92
301553	XSTR,6109,PNP,PWR,TO-220AB
302422	XSTR,VN0610,MOSFET,N-CHAN
303141	XTAL,32.768KHZ
128048	IC,WATCH DOG,GATE ARRAY
302627	IC,RAM,2KX8,CMOS,24 DIP
302695	IC,74HC373,H SP LTCH 20 DIP
303287	IC,80C31,MICROCONTROLLER,40DIP (non-FSO)
303910	FUSE,1.5A,250V,NORM-BLO
301073	WIRE,ELEC STRD,18 AWG,BLK
303249	ADPT,IEC PWR/CD CONN
303250	CONN,PWR/CD REC 3/P 6A 250V (597/598XA)
303467	FUSE HLDR,PNL MNT,FEF 031.1085
303489	FUSE,63MA 250V TIME LAG
139048	ASSY,LINE EMI FLTR,597XC/8XB
1001FAOPT98	CORD,PWR,DUTCH LOCK 220V

Software

Part Number	Description
143053	SERV,ASSY,MEM,1.10,597/8/9 FSO
136814	KIT,REV 10.05,ENG,599XC/8/7 (non-FSO)

Labels

Part Number	Description
138961	OVLY,SW PANEL,ITAL,598(BOM)
137603	OVLY,SW PANEL,SWED,598(BOM)
137605	OVLY,SW PANEL,SPAN,599FSO/598
136013	OVLY,SW PANEL,GER,598(BOM)
138675	OVLY,SW PANEL,ENG,599FSO/598
138593	OVLY,SW PANEL,DUT,598(BOM)
138975	OVLY,SW PANEL,FREN,598(BOM)
132335	OVLY,SW PANEL,ENG,597/9(BOM)
135734	LBL VPVP ENG 597 (BOM)
137281	LBL,SPACE*SAVER,AUST,597(BOM)
137619	LBL,VPVP,DUT,598(BOM)
138668	LBL VPVP ENG 598 (BOM)
135773	LBL VPVP FREN 598 (BOM)
135737	LBL,VPVP,GER,598(BOM)
137589	LBL VPVP ITAL 598 (BOM)
137623	LBL,VPVP,SPAN,598(BOM)
137621	LBL VPVP SWED 598 (BOM)
131866	LBL,SET LOADING, ENG,59X
131738	LBL,SET LOAD,GER,591/598
131739-000	LBL,SET LOAD,DUT,591/598
131740	LBL SET LOAD ITAL 591/598
131737	LBL,SET LOAD,SPAN,591/598
131735	LBL,SET LOAD,SWED,591/598
144178	LBL,SET LOAD,FREN,590/1/8
141565	LBL,TBG POSN,ENG,597/8/9
143671	LBL,TBG POSN,FREN,598
141686-000	LBL,TBG POSN,DUT,598
141682	LBL,TBG POSN,ITAL,598
141684	LBL,TBG POSN,GER,598
141683	LBL,TBG POSN,SPAN,598
141681	LBL,TBG POSN,SWED,598
126118	LBL,FLOW SNSR,DUT,281/581/591
126105	LBL,FLOW SNSR,GER,281/581/591
126124	LBL,FLOW SNSR,SPAN,28X/58X/591
126152	LBL,FLOW SNSR,ITAL,581/591
126106	LBL,FLOW SNSR,FREN,80/90SER
126119	LBL,FLOW SNSR,SWED,281/581/591
128100	LBL,FLOW SNSR,ENG,80/90SER
136006	LBL,NAME/RATING,ENG,597
136007	LBL,NAME RATING,598
1000LB01448	LABEL NAME RATING 59X
135708	LBL,START-UP,ENG,597(BOM)
137607	LBL,START-UP,DUT,598(BOM)
138671	LBL START UP ENG 598 (BOM)
135710	LBL START UP FREN 598(BOM)

Labels (continued)

Part Number	Description
135712	LBL,START-UP,GER,598(BOM)
137588	LBL START UP ITAL 598 (BOM)
137611	LBL,START-UP,SPAN,598(BOM)
137609	LBL START UP SPAN 598(BOM)
141421	LBL,START-UP,DUT,598 FSO
141333	LBL,START-UP,ENG,597XD
141334	LBL,START-UP,ENG,598XC
141400	LBL,START-UP,ITAL,598 FSO
141404	LBL,START-UP,SWED,598 FSO
141408	LBL,START-UP,SPAN,598 FSO
141412	LBL,START-UP,FREN,598 FSO
141416	LBL,START-UP,GER,598 FSO
1000LB01482	IVAC 597 START UP LABEL DUTCH
137613	LBL,ALARM MESS,DUT,598(BOM)
140166	LBL,ALARM MESS,ENG,598(BOM)
135913	LBL ALARM MESS FREN 598 (BOM)
138026	LBL,ALARM MESS,GER,598(BOM)
137587	LBL ALARM MESS ITAL 598 (BOM)
137617	LBL,ALARM MESS,SPAN,598(BOM)
137615	LBL ALARM MESS SWED 598(BOM)
1000LB01483	IVAC 597 ALARM MESSAGE LABEL DUTCH
141336	LBL,MESS,ENG,598XC
141335	LBL,ALARM MESS,ENG,597 FSO
141398	LBL,ALARM,MESS,ITAL,598,FSO
141402	LBL,ALARM MESS,SWED,598 FSO
141406	LBL,ALARM MESS,SPAN,598 FSO
141410	LBL,ALARM MESS,FREN,598 FSO
141419	LBL,ALARM MESS,DUT,598 FSO
141414	LBL,ALARM MESS,GER,598 FSO
133318	LBL,EQ POT CONN
137816	LBL,PATENT NTC,597/598/599
123273	LBL,GND SYM
137779	LBL,BATT,TYPE
136933	LBL CE MARK INST MDD

Test Equipment & Accessories

Part Number	Description
192	FLOW SENSOR
134646	ASSY,TEST JMPR,J3,590/99SER
305601	GAUGE,PIN,.160" PLUS
135740	SERV ASSY,TF,ADPT,CHRG,59X/599
1000SP01144	GREASE CASTROL LMX KIT

Appendix C

Fitting & Replacement Guidelines

Torque Guide

- ◆ Always use the correct torque level when making an assembly stage.
- ◆ Take care with the torque applied when re-assembling parts. Less torque is required, so a hand tool may be more appropriate.
- ◆ The head patterns of the fasteners are of the following types:
 - Phillips Number 1
 - Phillips Number 2
 - Torx Number T30
 - 4BA nut
 - 2BA nut
 - 14mm A/F nut
- ◆ Always select the correct tool and bit pattern for the fastener.

The following list outlines the torque levels established during product manufacture.

Torque levels selected apply throughout product life for the IVAC® Volumetric Pump (Models 597 & 598).

Use the information below as a guide to the 'do not exceed' torque levels when servicing the pump. When servicing, it is recommended that torque is applied gradually until the component is secure. In any process do not exceed the stated levels.

If a torque driver is available for servicing this will help control the applied torque; otherwise, be aware that excess force may cause the component to fail.

Note: If torque level is not stated then fixing should be hand-tight.

Front Case Assembly

Stage Description	Component Description	Qty	Established Process
			Torque
Follower Housing Assembly to Front Case	SCREW,MACH 6-32X3/8 PNH PHH	1	90cNm
Air-In-Line Assembly to Front Case	SCREW,MACH,4-40X5/8,PNH,PHH,SS	1	45cNm
Cam Housing Assembly to Front Case (Top/Bottom)	SCREW,MACH 6-32X5/16 PNH PHH	2	90cNm
Cam Housing Assembly to Front Case (Middle)	SCREW,MACH 6-32X1/2 PNH PHH	1	90cNm
Battery to Front Case	SCREW,MACH 6-32X5/16 PNH PHH	2	90cNm
Door Strike Plate to front Case	SCREW,MACH 4-40X3/16 PNH PHH	2	45cNm
Transformer to Front Case	SCREW,MACH 6-32X3/8 PNH PHH	2	90cNm
PE Harness to Transformer	NUT,KEP 6-32 S PL	1	70cNm
Display Board and Keyboard Assembly to Front Case	NUT,KEP 4-40 S PL	2	45cNm

Rear Case Assembly

Stage Description	Component Description	Qty	Established Process
			Torque
Logic and Power Regulator Board to Rear Case	SCREW,MACH 6-32X7/8 PNH PHHD	3	90cNm
Fuse Holders to Rear Case	HEX NUT (integral part of fuse holders)	2	70cNm
PE Harness to Rear Case	SCREW,MACH,6-32X3/16,PNH,PHH	1	90cNm
Power Cord Adapter/Mains Inlet to Rear Case	SCREW,TPG #4-20X.500 PNH PHH	2	90cNm
Pole Clamp to Rear Case	SCREW,MACH 6-32X1/2 PNH PHH	2	140cNm

Final Assembly

Stage Description	Component Description	Qty	Established Process
			Torque
Front Case to Rear Case	SCREW, INSERT MOLDED	4	80cNm

Appendix D

Service Contacts

Service Contacts

For service, contact your local CareFusion Affiliate Office or Distributor.

AE	CN	GB	NZ
CareFusion, PO Box 5527, Dubai, United Arab Emirates.	CareFusion, Shanghai Representative Office, Suite A, Floor 24, Shanghai Times Square Office Building, No.500 Zhangyang Road, Shanghai 200122, China.	CareFusion, The Crescent, Jays Close, Basingstoke, Hampshire, RG22 4BS, United Kingdom.	CareFusion, 14B George Bourke Drive, Mt Wellington 1060, PO Box 14-518, Panmure 1741, Auckland, New Zealand
Tel: (971) 4 28 22 842	Tel: (86) 21 58368028	Tel: (44) 0800 917 8776	Tel: 09 270 2420 Freephone: 0508 422734
Fax: (971) 4 28 22 914	Fax: (86) 21 58368017	Fax: (44) 1256 330860	Fax: 09 270 6285
AU	DE	HU	PL
CareFusion, 3/167 Prospect Highway, PO Box 355 Seven Hills, NSW 2147, Australia.	CareFusion, Pascalstr. 2, 52499 Baesweiler, Deutschland.	CareFusion, Döbrentei tér 1, H-1013 Budapest, Magyarország.	CareFusion, ul. Rzymowskiego 53, 02-697 Warszawa, Polska.
Tel: (61) 2 9838 0255	Tel: (49) 2401 604 0	Tel: (36) 14 88 0232 Tel: (36) 14 88 0233	Tel: (48) 225480069
Fax: (61) 2 9674 4444	Fax: (49) 2401 604 121	Fax: (36) 12 01 5987	Fax: (48) 225480001
BE	DK	IT	SE
CareFusion, Leuvensesteenweg 248 D, 1800 Vilvoorde, Belgium.	CareFusion, Firskovvej 25 B, 2800 Lyngby, Danmark.	CareFusion, Via Ticino 4, 50019 Sesto Fiorentino, Firenze, Italia.	CareFusion, Hammarbacken 4B, 191 46 Sollentuna, Sverige.
Tel: (32) 2 267 38 99	Tlf. (45)70 20 30 74	Tél: (39) 055 30 33 93 00	Tel: (46) 8 544 43 200
Fax: (32) 2 267 99 21	Fax. (45)70 20 30 98	Fax: (39) 055 34 00 24	Fax: (46) 8 544 43 225
CA	ES	NL	US
CareFusion, 235 Shields Court, Markham, Ontario L3R 8V2, Canada.	CareFusion, Edificio Veganova, Avenida de La Vega, nº1, Bloque 1 - Planta 1, 28108 Alcobendas, Madrid, España.	CareFusion, De Molen 8-10, 3994 DB Houten, Nederland.	CareFusion, 10020 Pacific Mesa Blvd., San Diego, CA 92121, USA.
Tel: (1) 905-752-3333	Tel: (34) 902 555 660	Tel: +31 (0)30 2289 711	Tel: (1) 800 854 7128
Fax: (1) 905-752-3343	Fax: (34) 902 555 661	Fax: +31 (0)30 2289 713	Fax: (1) 858 458 6179
CH	FR	NO	ZA
CareFusion Switzerland 221 Sàrl Critical Care A-One Business Centre Zone d'activités Vers-la-Pièce n° 10 1180 Rolle / Switzerland	CareFusion, Parc d'affaire le Val Saint Quentin 2, rue René Caudron 78960 Voisins le Bretonneux France	CareFusion, Solbråveien 10 A, 1383 ASKER, Norge.	CareFusion, Unit 2 Oude Molen Business Park, Oude Molen Road, Ndabeni, Cape Town 7405, South Africa.
Ph.: 0848 244 433	Tél: (33) 1 30 05 34 00	Tel: (47) 66 98 76 00	Tel: (27) (0) 860 597 572 Tel: (27) 21 510 7562
Fax: 0848 244 100	Fax: (33) 1 30 05 34 43	Fax: (47) 66 98 76 01	Fax: (27) 21 5107567

Appendix E

Disposal

Disposal



Ensure the Pump is disconnected from the AC power supply and switched off before attempting to service.

⚠ The Pump contains static-sensitive components and therefore strict ESD precautions should be observed at all times.

Only use CareFusion recommended spare parts.

Following all spare part replacement and repair activities, testing must be performed in accordance with the Performance Verification Procedure (PVP), see Chapter 3, Routine Maintenance.

Disposal

Information on Disposal for Users of Waste Electrical & Electronic Equipment

This  symbol on the product and/or accompanying documents means that used electrical and electronic products should not be mixed with municipal waste.

If you wish to discard electrical and electronic equipment, please contact your CareFusion affiliate office or distributor for further information.

Disposing of this product correctly will help to save valuable resources and prevent any potential negative effects on human health and the environment which could otherwise arise from inappropriate waste handling.

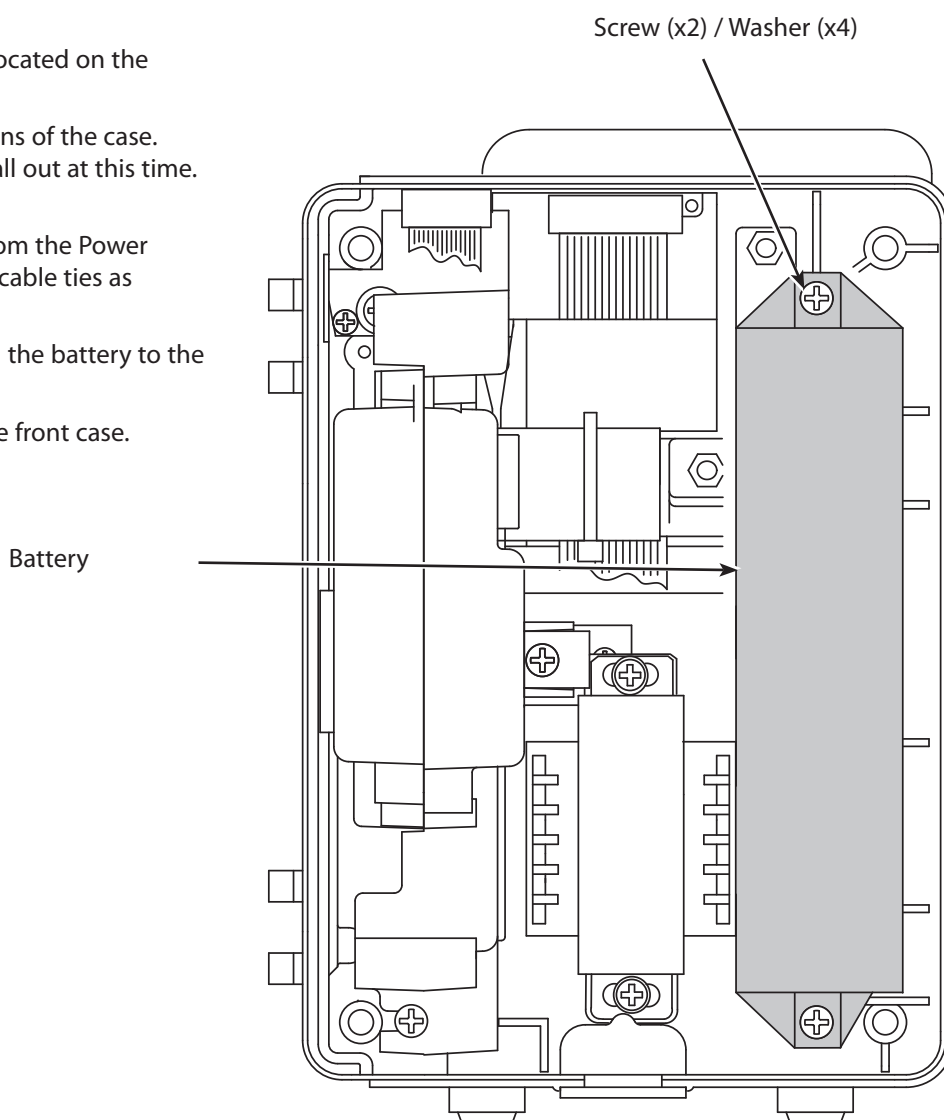
Information on Disposal in Countries outside the European Union

This symbol is only valid in the European Union. The product should be disposed of taking environmental factors into consideration. To ensure no risk or hazard, remove the internal rechargeable battery and dispose of as outlined by the local country regulations. All other components can be safely disposed of as per local regulations.

Battery Removal

Removal Procedure

1. Remove the four corner screws located on the back of the rear case.
2. Carefully separate the two sections of the case.
Note: The door hinge pins may fall out at this time. Take care not to lose them.
3. Unplug the battery connector from the Power Regulator Board (at J3). Remove cable ties as required.
4. Remove the two screws securing the battery to the front case.
5. Pull the battery up and out of the front case.



Appendix F

Document History

Document History

Issue	Date	CO No.	Author	Update Description
1	18/05/05	5571	Clare Coney	Initial release - (Supersedes 141745 and 137879)
2	4/11/05	6227	Ian Tyler	Moved Document History and Service Contacts to Appendixes Corrected Pressure calibration in Chapter 2 Added statement for test procedures after parts replacement in Chapter 5 Updated information on when replacing Cam Follower in Chapters 2 & 5 Rebranded from ALARIS Medical Systems to Cardinal Health
3	December 2006	7240	Ian Tyler	Correct Secondary operation. Change Manufacturer address. Add Disposal appendix.
4	October 2007	7988	Ian Tyler	Update spare part numbers.
5	February 2008	8246	Ian Tyler	Update spare part numbers
6	October 2008	8977	Ian Tyler	Update to add Dutch labels for 597.
7	May 2011	11538	Ian Tyler	Rebrand to CareFusion

This manual has been prepared for use by qualified service personnel only.
CareFusion cannot accept any liability for any breakdown or deterioration in performance of parts or equipment resulting from unauthorised repair or modification.

IVAC is a registered trademark of CareFusion Corporation or one of its subsidiaries. All rights reserved.

All other trademarks are property of their respective owners.

©1998-2011 CareFusion Corporation or one of its subsidiaries. All rights reserved.



CareFusion Switzerland 317 Sàrl,
CH-1180, Rolle



CareFusion U.K. 305 Ltd., RG22 4BS, UK